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THE SCIENCE OF PAINTING

THE HORSE.

BY

E. DUHOUSSET,

Lieut.-Colonel.

A TRANSLATION

LONDON :

PERCY YOUNG, 137, GOWER STREET, W.C.

THE
SCIENCE OF PAINTING.

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BY
J. G. VIBERT.

A TRANSLATION
FROM THE EIGHTH EDITION, REVISED BY THE AUTHOR.

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Books are dedicated to esteemed colleagues, to admired celebrities, to illustrious individuals, whose patronage the author thus hopes to obtain.

This book would be dedicated to the Institute of France, were such dedication permitted to any book.

TO THE READER.

THE author, at the conclusion of the course of public lectures which he gave at the "School of Fine Arts," has willingly consented, at the request of many of his hearers, to publish his lectures in this book, which he has now the honour of placing before you.

Having no pretension to give to his colleagues lessons, or even advice, except for the preservation of their works, the author will pass over all questions of beauty of drawing, of anatomy, of perspective and of composition, which form part of the *art* of painting, but which have no influence on its durability; he will only take up the practical part, or what might be vulgarly called the wire-pulling department. At the most he will only make some scientific digressions, necessary because certain effects cannot be properly understood unless their causes are known.

This book, the fruit of thirty years of study and experience, is the most serious and honest work which has been written on the subject. At least the author thinks so; and he must say so, for should he through excess of modesty say anything else, he would not be believed.

Notwithstanding the qualities which its author believes it to possess, will this book have the results which he expects from it?

Will it cause painters to adopt a more rational method? May we hope, thanks to it, to see the masterpieces of the future preserve their brilliancy and freshness?

Of that the author is not quite sure. Not daring to feel certain of great success, he will feel himself rewarded for his efforts if his book finds one reader from beginning to end, and you as that possible reader he now salutes.

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SCIENCE OF PAINTING.

CHAPTER I.

THE PROCESS OF PAINTING AT DIFFERENT PERIODS.

As soon as men collected together anywhere to live as a society, they had a religion and an art, whose first manifestation has always been painting.

The primitive process employed was everywhere the same. It still exists in all its simplicity with some savage tribes who use it to paint their idols, their utensils, their firearms, and even the bodies of their warriors. This process, limited to the use of argillaceous earths, naturally coloured by the presence of metallic oxides, or to dyes obtained from the decoction and the sap of certain plants, consists in mixing earth with water to form a coloured paste, and then by means of a little stick, or merely with the finger, spreading it over the object to be decorated. This is a very simple method!

And yet, although this first process is so very elementary, it contains the germ of all the others; and we are about to see that the numerous colouring-matters placed to-day by nature and science at the disposal of painters are nearly all combinations of three elementary substances—clay, metallic salts, and vegetable dyes.

This was afterwards improved by mixing gum with these elementary colours, to obtain more substance and more brilliancy.

The Egyptians have bequeathed to us on their mummies specimens of these first gum paintings, which they further covered sometimes by melted wax, and which, being thus preserved from contact with the air, have retained an extraordinary freshness.

In the most ancient times the use of coloured clays, incorporated with lime and cement, was customary, and also the manufacture of terra cotta covered with vitrified substances. Such are the coarse enamels and cements of various colours, which, broken into little cubes and afterwards encrusted in fresh mortar with other pieces of marble or stone, constitute the earliest specimens of mosaic work.

In the heroic age of Greece, the painter introduced those same colouring matters, reduced to fine powder, into melted wax; often he added resin to this, and spread those masses softened by heat on the surfaces which he wished to decorate, by means of a bronze spatula slightly warmed. Afterwards, with the other end of the spatula, which was pointed, he drew, on the yet soft surface of colour, the object which he wished to represent; and after having broken off all that was outside the outlines he filled up the place left vacant with paste of another colour.

In this manner were painted the prows of the ships which carried the Greek kings during the Trojan war.*

In short, until then, the art of painting had much in common with that of sculpture, and only consisted of flat tints. Much later, with the use of the paint-brush, the first attempts at shading appeared.

* This kind of painting has lately been resumed, and a picture painted by this process was on view at the last Salon.

The artists of those days could, by spreading ground colours mixed with water on fresh mortar made of sand and lime, produce graduated tints; and the first pictures worthy of the name were painted after this invention of fresco-painting. They painted afterwards with resinous gums into which was introduced wax, rendered miscible with water by the help of lime.

This process finished, the painting was moved backwards and forwards before a bronze chafing-dish, in the form of a grating filled with hot coals and called a *cauterium*. The wax and the resin, melting under the influence of the heat, then formed, with the colours, a homogeneous whole whose durability was almost unlimited.

Paintings done by this process have been seen in a perfect state of preservation nine centuries after they had been painted, although they were on outside walls exposed to all the injuries of the weather.

In the same way the Greek sculptors coated over their marble statues, to preserve them and to give them a verdigris of which unmistakable traces are still found on some fragments.

At last, when by distillation they were able to extract essential oils from certain plants, painters made varnishes by dissolving resins in these essential oils, and one may say that then the painting of the ancients attained its apogee. In fact, a picture of this period painted on lava was exhibited at the Universal Exhibition of 1889 in the Industrial Court, and all who saw it were struck with its extraordinary state of preservation.

These different processes of antiquity were continued almost until the Middle Ages, when the use of wax was almost entirely discontinued, being superseded by egg painting, which rapidly became general. The miniatures

on the parchment of missals, the panels of costly shrines, the pictures painted on three-folding panels which ornamented the altars and the walls of churches, were mostly painted by this process which is very substantial, as it admits of the introduction of resins—the yolk of egg containing an oil capable of dissolving the resins.

Oil painting began in the fifteenth century. We are not here going to enter into that great discussion, which is not yet finished, as to whether oil painting was really discovered by Van Eyck, but perhaps we may venture to say that its discovery was really caused by a mistake.

In the first place, neither John Van Eyck nor his brother ever acquainted anybody with their processes, and their secrets died with them; and if report is to be credited, they were even so jealous that they stabbed one prying individual who ventured into their studio.

In vain distinguished artists, attracted by the fame of the two brothers, came from Italy to Bruges: they could learn nothing, except that the belief spread that Van Eyck owed the exceeding brilliancy of his colours to the use of oil.

Now, at that time the word oil was used indiscriminately for all the slimy liquids which could be extracted from plants without the use of heat, and some of which certainly are essential oils. People did not know that such could be obtained also from the hard yolk of egg, and that these essential oils form with resins thick varnishes which have all the greasiness of true oils, and give to colours a transparency and a richness surpassing that given by oil alone.

What is certain is that, from the processes of Van Eyck, only one word transpired, and that was—oil! We now know that this word could be used with a double meaning; but for the painters of that date it was otherwise: they hastened to grind their colours with any sort of oil in order

to imitate the great inventor, and yet they never succeeded in equalling the powerful colouring of his pictures.

Now, among the adepts at this new style of painting there were some great masters who ought to have been able to make as good use of the method as Van Eyck himself: we may therefore permit ourselves to say that the process, such as it has been employed since his time, was perhaps not his, or that it has been badly understood, for if this great painter really did use the oils which are still used to-day, he never used them except when much imbued with resin on panels prepared with size and outlined in egg: so that the oil colours applied semi-liquid or in glaze only merely exist as pellicles in his pictures.

Not being able to penetrate the mystery which envelops the invention of oil painting, and convinced that, if it was Van Eyck who discovered it, he did not practise it as it has been practised since his day, we shall content ourselves with saying that the use of oil painting spread rapidly after Van Eyck's death, which occurred in 1450, and that, with regard to results obtained, the Flemish and Dutch schools were those which most nearly approached the great painter of Bruges—which allows us to suppose that they also approached him most nearly in technical methods.

The custom of painting on surfaces prepared with size and of adding resin to oil-colours was continued for more than a century afterwards in Flanders. Otto Venius, the master of Rubens, retained the method, and Rubens himself painted all his first pictures in the same manner. When, later on, he used thickenings, it was only in the light colours, and he never abandoned the use of coatings of size.

After this incomparable master, the method fell into disuse. Resins were no longer employed, which necessitated increasing the proportion of oil; canvas and panels

were prepared with coatings of oil, and thick layers of oil colours were put over them. To this abuse of oil was added that of turpentine; and the painting, gradually losing its transparency, took a dull and floury appearance, and this went on increasing until the end of the eighteenth century.

At the beginning of the nineteenth century all these traditionary methods disappeared, neglected by those who ought to have taught them, forgotten by those who ought to have practised them, and at last entirely unknown to the new generation.

This generation, that of 1830, hastening to reverse everything, yet understood that a method was necessary, and they created some new ones: they created many, even too many, for not one of them was good. Never was so much written about painting as at that time, and never was painting so bad in point of substance; each group, each artist even, had formulas which he kept secret.

One of them, facetiously inclined, wrote on the little bottles which lay about in his paint-box, "Oil of Perlimpinpin," "Balm of Apollo," "Aerial fluid," etc. What looks of envy the pupils in his studio cast on those treasures! How much they would have liked to have used them! And later on, when they saw how brown the pictures of this old magician had become, how they congratulated themselves that they had not been able to do so!

To-day, artists have no longer any of that paltry jealousy, and, disdaining even to occupy themselves with the material part of their art, they leave the care of preparing their canvas and their colours to grinders who come down in hordes from the mountains,—we shall not say what now ains, so as to wound no susceptibilities.

Those clever but ignorant colour-dealers invent oils, pomades, siccatives, etc., and under pompous names they

manufacture disastrous mixtures of colour. They furnish everything : the box, the easel, the paint brushes, the subjects of the pictures, even their own advice and the favourable opinion of the critics.

The modern artist, furnished with all this amateur stock of wares and having no need to think of his requirements is free to follow the dictates of his fancy. He paints casually, without thought of the morrow, being merely desirous to follow the fashion, for that is important ! There are exquisite tints which it is necessary to have : veined flesh, marble transparencies, dull softenings, dusky shading, etc. ; there is not enough of that variety,—there must be more, the journalists insist !

Warm colours ? enamel ?

No more of that !

And then there are the treasures of the virtuoso, the all powerful touch lovingly exhibited !

As for the vagaries of the paint brush invented by Paul de Saint Victor, they are old.

And yet the masterpieces of yesterday, scarcely in the museums, get dark, crack, and weep tears of bitumen ! In the monuments, the new frescoes get mouldy, peel off, fall from their places ; and the contemporaries who have seen when they were new the works of Henry Regnault and of so many others are obliged to tell to the young people who are unwilling to believe them, that the colours in those works were extremely brilliant and fresh when new.

It is only necessary to take a walk in the Louvre to see that the preservation of the picture is in direct ratio to its antiquity : that is to say that in the paintings of the fifteenth century, to go no farther back than that, the colouring remains more brilliant and the materials more substantial than in those of the sixteenth century, and that in approach-

ing our own time the painting deteriorates more and more ; those paintings which are in the worst state of preservation are not many years old.

Whose fault is this ? Alas ! it is that of artists themselves, for their indifference surpasses all bounds.

But, are they seeking to excuse themselves ? "What are we to do to make our painting imperishable ? Nobody ever spoke to us of it. Our professors themselves knew nothing about it." That is partly true. Therefore do not let us recriminate, and let us forgive those who have gone before ; but, so that those who come after us may be wiser, let us find again those lost traditions which we shall do our best to perfect with the help of the discoveries of modern science.

With this object we shall study all the materials employed by our predecessors, beginning always at the times of greatest antiquity and coming up to our own days ; thus learning, by the use which the ancients have made of their methods and the results which have reached us, what ought to be retained and what ought to be abandoned. We shall thus be able, on a sure basis made by the experience of many centuries, finally to establish the essentials of the material processes of painting, and, shedding abroad the light into the darkness of ignorance and empiricism, bring forth from it a new science.

CHAPTER II.

LIGHT AND COLOURS.

It is not enough to give to artists good material to ensure the durability of their works, if those materials are badly used ; and it is not possible to indicate in a general manner how they ought to be used, as each object painted requires a different style of execution.

The painter should obtain from his colours, by the different manners in which he puts them on by means of oils and varnish, all the effects of transparency, of opacity, of brilliancy, of dulness, etc., which light is capable of producing. Each of these particular manners of using the same materials so as to give a durable result necessitates special precautions which we shall indicate ; but in order properly to understand how one can reproduce artificially all the phenomena of light and of colour which present themselves to our eyes, it is indispensable first to know how they are produced in nature.

According to the most modern theory, the luminous bodies by themselves, the sun, the stars, the flames, are composed of molecules in a state of perpetual vibration. This vibratory movement, communicated to the surrounding molecules, produces circular waves which, rolling off into space, cause to us when reaching the retina the sensation of light, in the same way that the sonorous waves when reaching the tympanum cause to us the sensation of sound.

Some of these luminous waves are absorbed by bodies which they encounter, and thereby undergo chemical changes; others make their way through transparent media, such as air, water, glass: this is the phenomenon of *transmission*. If they meet opaque bodies which stop them, they rebound and are thrown back into space: this is the phenomenon of *reflection*.

But, according to the density of the transparent mediums, and according to the matter, the form or the nature of the surface of the opaque bodies, they are transmitted or reflected in different conditions.

In mediums of homogeneous transparency they are transmitted in a straight line, but the direction changes as soon as they pass into a medium of another density: for instance, a stick plunged into water appears to be broken, that is called *refraction*. When the waves are bent back by an opaque body to a polished surface, the *reflection* is direct or *specular*, as by a mirror, for instance. In this case, if the light strikes the object perpendicularly, it comes back upon itself; if it strikes obliquely, it is sent back in the same oblique manner from the opposite side to the one whence it comes. When the body has a rugged surface, the luminous waves are sent back in all directions: this is *diffuse reflection*. But a body may be more or less transparent or opaque in its entirety, or composed of some parts very transparent and others very opaque. It may have a surface more or less polished or rough, or it may be composed of some parts very polished and others very rough; so that, combinations of transparency, of opacity, and of rough and polished surfaces being unlimited, the phenomena of *transmission* and *reflection* of light are also unlimited.

On those general laws are still to be grafted the effects

of concave or convex surfaces—the convergence or divergence of rays; the effects of *multiple refraction* from surfaces cut in facets; the theory of prisms, etc., which constitute the science of optics, upon which we cannot here enter, but which painters would do well to study.

Now that we know how His Majesty the Sun gives us this beautiful ray, we should also like to know of what it consists.

Beautiful sunbeams for our information enter this dark room, go through this little hole, and afterwards cross the prism. There! Now the beautiful ray is analysed, spread out on a screen. It is now a luminous band divided into seven distinct colours: *red, orange, yellow, green, blue, ultra-marine, violet*; and the sharp and learned analyst, getting ready to dissect it, calls it at this point the Macabrean name of *solar spectrum*.

Under the scalpel of science this spectrum reveals strange secrets. It shows the process of *spectral analysis*, thanks to which we are able to learn something of the chemical composition, not only of the stars in our planetary system, whose light comes to us in a few minutes notwithstanding the millions of leagues which separate them from us; not only of the most distant stars, whose light takes years to reach us, but even of the nebulae, which, yet farther off, are lost in the infinitudes of space, where all thought or calculation would mean madness, were it not that there is found—God!

By the help of various prisms and decomposed rays, the analyst in his dark room places in juxtaposition and in superposition colours which are very interesting, but which it will be more profitable for us to consider later.

He establishes the fact that the coloured rays cannot be decomposed, that their refrangibility increases when they are

taken from left to right, and that they have each different undulations, of length, which go on diminishing from red, where they are 620 millionths of a millimetre, to violet, where they are only 423 millionths of a millimetre.* On account of this the number of their vibrations per second increases from violet, which has 752 trillions of vibrations, to red, which has no more than 514 trillions. Finally, the analyst, reuniting the seven coloured elements of the poor sunbeam by means of two prisms placed opposite to each other, is thus able to reconstitute the white light.

Beautiful sunbeam! you have taught us our lesson: you are now free.

If the beautiful sunbeam could speak, it might tell us that, since the beginning of the world, the secret of the decomposition of light has been under every eye; that sunrise and sunset, the rainbow, the iridescent fringe of the glaciers, the thousand fires of the diamond, might have taught us; and that there was no need to drag a poor sunbeam into a dark room in order to teach us. Whilst hearing this, man, so proud of his learning, might well feel ashamed of the time it had taken him to learn.

Before studying colours, we are confronted with one primary question.

Why is a body red or yellow or blue, etc.?

We do not know. But if we do not know the cause, at least we may learn the effect of this phenomenon.

All bodies do not act alike under the action of the light which they receive. They have the mysterious property of absorbing either the whole or part of that light, or sometimes after having decomposed the light they only absorb certain coloured rays of it. Some bodies have only the faculty of absorbing, others have only that of decomposing.

* A millimetre is 1001 of a metre.

Others, again, reunite in different proportions the faculties of absorbing and of decomposing, and those are the differences which determine the colour peculiar to each of them; for the colour of a body is the sensation which is produced on the retina by the portions of light which it has not absorbed, and which it sends back.

All absorbed light produces darkness. A body which would absorb all the light which it receives would be quite dark; it would be impossible to distinguish either light or shade. A body which would absorb nothing from the light which it receives would be just as vivid as that light; but these two extremes, altogether unmodified, are not met with in nature.

A body which absorbs part of the light and sends back the rest is grey. The whitest objects, therefore, are only very light grey, and the blackest very dark grey. However, the light which a grey body sends back is the same as that which is sent back by a white body: the difference is merely in quantity. Why do those two lights of the same quality give different sensations? It is because, the light being shed equally over all bodies, our eye, in comparing the luminous intensity of several objects lighted by the same light, can perfectly distinguish the quantity which each of them absorbs, and our eye supplies the missing quantity with an equal amount of black. Consequently, if a body only sends back the half of the light which it has received, our eye has the sensation of a grey composed of half black and half white.

All decomposed light produces the seven coloured rays of the spectrum. The bodies which, after having effected this decomposition, absorb one or more of these rays and send back the others are of the colour of the ray which they send back, if they send back only one, or of the colour

composed by the mixture of the rays which they send back if they send back more than one.

Example.—A body which absorbs six rays and sends back only the red is red, and so forth.

If a body, having absorbed a part of the light which has received, instead of sending back the rest decomposed, the colour of the coloured ray, or of the mixture of coloured rays which it will send back will be more or less darkened, according to whether it shall have absorbed much or little of the light.

Example.—A body which absorbs the half of the light received, decomposing the remainder and only sending back the red ray, gives the impression of half-black and a seventh of half-red, *i.e.*, a dark red.

If, on the contrary, a body sends back a part of the light received, and decomposes the rest, the colour of the coloured ray or of the mixture of coloured rays which it will send back will be of a colour more or less light, according to the quantity of light sent back.

Example.—A body which sends back the half of the light received, decomposing the remainder, and sending back only the red ray, gives the impression of half-white and a seventh of half-red, *i.e.* pink.

It is, then, in fact, the mixtures of colours between themselves, and the large or small quantity of light or darkness which is added to them, that gives the millions of shades discernible in nature and which in painting is called colouring.

But in the mixtures of colours much difference exists between mixing coloured rays and mixing coloured matter. Two rays of the same light passing one through a pane of blue glass, the other through a pane of yellow glass, give at the place where they meet, a white light. If, on the

contrary, the two glasses are placed one over the other, the light transmitted will be green; and if, reducing the two pieces of glass to powder, the powders are mixed, the light reflected will still be green.

In order to explain the reasons of this phenomenon and of many others, it would be necessary to enter into a number of scientific causes sufficient to drive an artist mad. Besides, as we never do have at our disposal on our palette the rays of the spectrum, and consequently cannot utilise them, any more than we can the effects of *polarisation*, of *phosphorescence*, of *efflorescence*, etc., we shall leave all that for the consideration of those material colours which are all that remain to us when we pass from the study of physics to that of painting.

Those colours which consist of matter ground with different substances may be had in conditions more or less transparent or opaque. They act on the eye by *transmission* and *reflection*, and consequently give different results according to the conditions in which they are used.

In fact, if you add a colour to opaque white, you will not obtain the same shade as if you were to rub a thin coating of that colour on the white. In the same way a colour added to opaque black does not give the same result as if it were transparently put on that black.

By this rule, two or more colours have different effects according to whether they are mixed in an opaque condition or laid one over the other in clear coatings.

The use of colours of different degrees of opacity constitutes what is called, in studio terms, *solid* and *semi-liquid*; and the use of different degrees of transparency, *scumbling* and *glazing*.

The appearance of a colour changes also according to the nature of its surface and the manner in which it is

painted: the surface can be rendered dull by *flaking*, smooth by using the *badger brush*, or rough by *dabbing*; effects of vibration are to be obtained by strokes called *hitches*.

In fact, a painter who knows his trade finds means of making his colours take all the different aspects which they present in nature; thus bringing into action unawares, as M. Jourdain made prose, all the phenomena of *refraction*, of *specular reflection*, and of *diffuse reflection*, by means of which the coloured rays manifest themselves to our organs of sight.

The artist obeys, therefore, immutable laws which he does not know. How can he do it? The reason is that the laws of colour, like those of perspective, painters had felt before science had discovered them, and that artists have them all, more or less, by instinct.

How much quicker, however, they would arrive at this facility by knowing, from the outset of their career, those laws which are unchangeable and which they only arrive at, using unconsciously later, after many attempts and jumbling efforts!

Yes; but where are they to be learned?

Not in treatises on physics, where they are mixed up with all the questions of optics and of chemical and caloric luminous rays. Neither is it in works specially written for artists by professors, grave but inexperienced, who have no proper knowledge of what painting really is.

Oh, no! Without having seen them, one would not dare to believe it possible to write the contents of some of those volumes.

In one which has very recently appeared, the author tells us: "In order to paint the head of a young man of white race, twenty-one years of age" (not twenty-two or twenty-

three—exactly twenty-one), “mix such and such colours for the brow, for the eyes, the lips, the cheeks,” etc., and the author draws out a plan of cipher for his directions. It is true that this laughable author informs us that he did not invent the notation (which is to be regretted!).

The predecessor had expressed the cheeks of the young man by this formula :—

$$4 \text{ red } \frac{3}{10}, 4-5 \text{ shade};$$

but the new writer changes the formula and thus simplifies it! The young man’s cheeks are written :—

R 1 a	Oi No
R 1 i	Oa Nu

Ah! what genius!

It is works of this kind that give the proportions of colour to be mixed in order to make the shades of the leaves of all the trees, the lakes and the rivers of Europe, the mountains of Switzerland, etc.; to imitate the brightness of the rose, the velvet of the peach, or the flames of a fire; to reproduce the tints of the human skin in all races of the universe, from the ebony skin of an African negro to the pearly colour of a patrician; and one limits precisely all the shades according to whether one is painting an infant, a child, a young girl, or a grandmother: they do not give us the recipe for painting a woman who conceals her age; perhaps all the colours should be mixed up together. Finally, they even furnish us with the colour of the passions—the deadly paleness, the blue of anger, the red of shame, and the carnation of bashfulness! All that is a good deal. Too much to be discovered by a single artist!

Let us suppose now that a pupil of this professor paints a picture, following out from point to point his programme:

it is soon done. It is of a noble simplicity, a triumph of local colouring, a masterpiece of to-morrow : it is sold, or offered to the Louvre, and here we leave it.

But if a thoughtful pupil were tempted to try in his turn, he would first think in this manner : We take a ball and we smear it all over with any colour, say vermilion. We shall next make a copy of this ball in painting. Do you think that for this purpose we can use the same vermilion ? Yes, but only for one stroke of the brush—that which corresponds to the exact middle of the ball ; for, at all the other points, the colour is modified by the bordering of light, the reflections of neighbouring objects, the shadow and the half-tints which constitute the shading, and we should require almost all the colours of the palette in order to reproduce these modifications.

Now, here is a picture representing an orange tree laden with oranges : we shall leave the fruit and proceed to darken the foliage, and also the sky and the earth. In fact, we now produce the effect of night, and the oranges, which have not changed their colour, are become luminous balls like those which adorn the trees on fête nights.

Now, let us take a white canvas on which we paint one touch of a brilliant green. Well ! according to what we paint round it, you may make of that touch whatever you like : an omnibus lantern, with a background of Boulevard at nightfall ; a leaf illuminated by the sun, in a green bower ; the sacred emerald which shines on the brow of the god Buddha in a Hindoo temple. Without changing anything, this touch may lose its brilliancy and play the rôle of a lizard in half-tints amidst the effulgent odalisks of Diaz, or it may be lost in the shadow of a stake outlined on the Grand Canal at Venice, touched by the light of an Italian sunset.

Thus, a material colour, placed in a picture which remains lighted by the same light, changes its tone according to its surroundings.

Delacroix said: "Give me some mud, I will make of it the skin of Venus, if you leave to me the choice of the surroundings."

It is the same thing in nature, where the colour of a body can be modified to any extent by the degree and the colouring of the light which it receives from the reflection or the mere contrast of the colours near it, etc.

Let us follow a cardinal, dressed in red, whilst he walks in his gardens. At every instant the colour seems different, according to whether he receives the blinding rays of the sun, or the white reflection from a cloud, or shelters under the verdant shade of a leafy grove. Whether we see him on the intense green of the sunny lawns, under the dark green of the cypress, on the silvery surface of a lake, or under the azure of the sky, he still changes. He changes always, becoming pale before a bank of geraniums, and red before the marble of the statues; he gets dark in proportion as the daylight fades, until he becomes of a dark purple, and is dressed in black, like a simple priest, as he returns to his palace by the dusky shades of twilight.

There is still another reason why the colour of a body cannot be defined by a formula: it is that the colour does not appear alike to every one. Although it is said that "Tastes and colours should not be discussed," and although popular sayings have always a foundation of truth, that would not be a sufficient proof; we require better arguments.

We said that light had other properties besides that of enabling us to see. It develops heat, and it acts as a chemical agent. If we move a thermometer under the different coloured rays of the spectrum, we shall see that

heat increases from violet to red, and passing red it continues to increase, although in the shade, to a culminating point which is to be found left of red, at a distance equal to that existing between red and yellow. Starting from this point heat diminishes, but it is still appreciable at a distance from red equal to the extent of the entire spectrum.

As for the chemical effects of light, it is impossible to name them all. Let us merely think of those forming the basis of all photographic processes. These may be of great violence, since chlorine and hydrogen, which are without effect upon each other whilst in darkness, combine explosively when they are exposed to the sun.

The chemical power of the coloured rays of the spectrum, contrary to those of heat, increases when going from red to violet. Farther than the last violet rays, we finish by perceiving another shade, to which the name of lavender grey has been given; in the same way that beyond the red is now distinguished a beginning of a darker shade named crimson. The truth therefore is that the *solar spectrum* stretches from the extreme point, where heat begins to be felt, to the other extreme point, where all chemical action ceases; but to us it is only visible in its central part. We say now visible, because our organs of sight becoming unceasingly, not stronger, but more delicate, we already see better than formerly; and perhaps a day may come when we shall be able to distinguish yet more than we now can.

With this reasoning we must admit that the ancients had not the power of seeing all the colours which we see.

Well! but why not?

Certain scholars have already tried to prove that the ancient painters did not use either blue or violet, and that the language of Homer has no words expressive of those colours. Are we to infer from this that there was once an

epoch when these extreme shades of the spectrum were not yet seen?

At all events, amongst organised beings there exist some who, gifted with an organ of vision enabling them to perceive light, nevertheless do not see colours, or only see certain colours. Little crustaceæ of a particular kind, in a globe full of water, frisk about, and hasten towards a jet of light, if that light is presented to them of a certain colour, and do not move if the light is not of that particular colour.

The human race presents similar anomalies. Certain people, affected with an eye malady called Daltonism, are unable to distinguish all colours. It has been remarked, since examination has been compulsory to the employés of the railway companies, how great is the number of Daltonians amongst those men who present themselves for examination. The proportion is quite as great amongst those who do not present themselves; only these latter generally have no suspicion of their infirmity. Many are artists, and some are even very talented.

One of them, whom we knew as a student, could not distinguish red from green. To him, vermilion and Verona green were identical. He was guided by the labels on his tubes, and, knowing by hearsay the use of these two colours, he painted moderately well. There certainly were, here and there, some wandering touches which "howled" a little, in studio phrase; that passed for originality. But having one day, by inadvertence, taken the palette of a neighbour who did not arrange his colours in the same order as himself, the secret was discovered. All those who have seen it must still be able to remember the academical figure of the ancient wrestler, conscientiously painted in all the greenest tints of spinach and leeks. One can imagine the burst of laughter which this caused amongst his com-

rades ; it was spoken of for a long time. The poor boy, in desperation, dating from that memorable day, cleared from his palette all reds and brilliant greens, and contented himself with painting subjects not requiring much effect from colours. As he drew very well, had the idea of relative values well developed, and keenly felt the poetry of nature, he became, in spite of all, a great artist ; only no picture ever left his studio without a friend sincere (but indiscreet as you may see) coming to make sure that no mistake had slipped in, and that the few indispensable reds were well in their places.

We may therefore conclude from the preceding examples that the colour of a body is perpetually modified by all sorts of causes, and that it is not the same to every eye.

If, therefore, professors, imposing but ignorant, having no knowledge of painting (we must repeat it), dare any longer to wish to formulate the precise colours of objects, may they be the laughing-stock of the lowest of the colour-grinders !

CHAPTER III.

THE LAWS OF COLOURING.

THE seven colours given by the decomposition of light seem to melt insensibly into each other ; but a practised eye distinguishes almost a thousand shades in the extent of the *solar spectrum*.

The presence has also been ascertained of about two thousand dark rays, which separate those shades into unequal parts.

All scientists, however, are not agreed about choosing exactly amongst those shades the seven normal colours.

One considers red as being a little nearer to orange, for instance, and the other considers it to be a little farther off, etc.

That alone would render impossible the establishment of a normal universal spectrum. It has been proposed to decide with common consent, that the true red, the true yellow, etc., should be between such and such rays, these latter remaining always in the same place. Unfortunately, if the rays are immovable the shades are not ; they change according to the intensity of the light which produces them : when the light increases, all the colours of the spectrum go nearer to the centre, which is greenish-yellow : then the yellow becomes a greener yellow, the orange yellower, the red more orange, the crimson redder ; and on the other side of the centre the green becomes a yellower green, the blue

greener, the ultramarine bluer, the violet more ultramarine. On the contrary, in proportion as the light diminishes, the colours get farther from the centre: the yellow becomes more orange, the orange redder, the red more crimson, and this last, going on towards darkness, becomes darker. On the other side of the centre, the green becomes bluer, the blue more ultramarine, the ultramarine more violet, and this last like crimson, going on towards darkness, gets darker.

So that, if you decree, for example, that the true red is between such and such rays, as the red moves to the left or to the right according to the intensity of the light, the red will not always remain between those rays, for the rays do not change place.

It would therefore be necessary to establish some practical means of measuring this intensity of light, so that we might say: it is at such a degree of luminosity that the spectrum should be consulted.

Whilst admitting that that might be possible, there still remains one objection: it is that light is differently coloured according to the season, the climate or the hour of the day.

After these explanations it is easy to understand why those who have tried to fix a universal standard have all failed.

But even if we could overcome the difficulties which oppose the realisation of this standard, what practical results should we obtain from it?

You ask a manufacturer for a stuff of a certain shade by this standard; but according to the material which will be dyed to prepare the stuff ordered so will the shade differ. Yarns of silk, wool or cotton, having surfaces more or less shiny, will reflect back the white light in a small or great degree, and, being twisted or woven in different ways, there will be effects of *multiple reflection*, which lighten or darken

the colour. And if an artist wishes to make use of this standard, if he put colour of the normal tone on his palette, what will be the use of it to him? As we have seen, the material colours which he uses change their tone according to the manner in which they are used, and according to their surroundings; without counting the chemical reasons which cause them to vary still more.

If we are stopping in order to protest against this non-existent colour standard, it is because it is being constantly proposed in special works all very unpractical, as, for example, in a recent *chromatic summary*, where the author gives chromo-typography tables in which all the shades correspond to written formulæ. Only, he artlessly tells us that his shades have not come out very well, and, further, he begs us to keep the book shut as much as possible, to prevent his plates fading from exposure to the light. And in this manner he professes definitely to settle colours.

That, would be very amusing were it not that such volumes written for artists do great harm to those who read them. In fact, their perusal is time wasted, and by always reading without understanding one loses all desire for learning.

The *solar spectrum*, as we have just seen, has only one fixed point. It is a *yellow-green*. From it we can go to violet, which is the last perceptible colour on the right, the left extreme being a deep crimson.

As soon as the human mind seeks to penetrate the secrets of nature, it finds always infinitude—that great hope!

Infinitude is represented by the figure of a serpent biting his own tail: this is a bad illustration, for the idea of a circle, a closed and imperfectible figure, more properly represents a proud despair. This idea fits in with those which declare that when human sensation stops all is finished; and, as regards our present subject, somebody

should think of considering the *solar spectrum* as a definite whole and uniting the two extremities. This suggestion has not been lacking. It is fortunate that to prove the folly of this conception we have other arguments than philosophical fancies.

In the first place, the theory of luminous waves does not allow us to suppose that the shortest waves can be immediately joined to the longest; further, the laws which regulate the mixtures of the colours of the spectrum would not apply at all if it were desired to mix the extremities. Thus violet, returning to the side of red and mixed with it, does not give the hue in which crimson takes its origin.

It is a very convenient theory that colours are arranged in a circle, but as it is not true it must be renounced. It is like the three primary colours which founded all the others. But that is another mistake. It is true that green can be made with yellow and blue, orange with yellow and red, and violet with red and blue; but this green, this orange and this violet are darkened, by a phenomenon of *interference* which it would take too long to explain here. The primary colours would have to be soiled to make them harmonise with the compound colours, and we should have to be satisfied with a circumscribed palette which could have no crimson. Yet crimson exists in nature, and painters cannot dispense with it if they wish to reproduce all they see.

Having explained why we must renounce, with reference to painting, the study of the mixtures of the coloured rays themselves, we shall therefore begin by treating them as palpable substances, and copy the *solar spectrum* with the material colours which are at our disposal. Leaving all scientific experiments, we shall collect the phenomena which produce the mixtures of these colours, their super-

positions and their contrasts, under the general name of *laws of colouring*.

MIXTURES OF OPAQUE COLOURS.

Colours prepared to an equal degree of opacity and of luminous intensity will be arranged on a black palette in the order of the spectrum. Certain mathematical coincidences which we find in the mixtures of colours being of use to us, they are numbered so as to distinguish, immediately, the odd numbers from the even, and the fixed point at yellow-green is marked by a cross; moreover, each space between two colours representing the intermediate shades, is separated into five equal intervals, which divide the spectrum into thirty-seven degrees. The shades are further subdivisible, as the eye can perceive a thousand of them; but that would be useless for our demonstration. On left and right, crimson and violet occupy the degree No. 3 of the intermediate shades between the two extreme colours and those unknown.

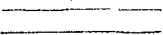
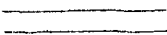
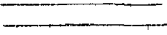
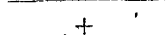
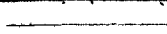
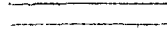
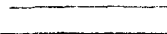
Mixtures of Two Colours.

1. When two colours come together, their mixtures, in all proportions, produce the intermediate shades with all their luminous and colouring intensity.

Example:—Red and orange produce all the shades of red-orange and of orange-red; blue and green, all the shades of green-blue and of blue-green, etc.

2. The mixture in equal parts of two odd colours separated by a single other, produces the colour which separates them, but with less colouring intensity.

Example:—Red and yellow produce an orange greyer

Crimson . . .		
		
Red		1 odd.
		
Red-orange .		
		
Orange . . .		2 even.
		
Yellow-orange.		
		
Yellow . . .		3 odd.
		
Yellow-green .		fixed point.
		
Green . . .		4 even.
		
Blue-green . .		
		
Blue		5 odd.
		
Blue-ultramarine		
		
Ultramarine .		6 even.
		
Violet . . .		

Whilst reading what refers to it, you would do well to have a copy of this list.

than the normal orange; yellow and blue a green greyer than the normal green.

3. The mixture, in equal parts, of two even colours separated by a single other, produces a grey somewhat approaching the colour which separates them.

Example.—Orange and green produce a yellowish grey, green and ultramarine a bluish grey, etc.

4. The mixture in equal parts of two colours separated by two others, which consequently is always the mixture of an odd and an even colour, produces a grey approaching the odd colour.

Example.—Red and green produce a reddish grey; orange and blue a bluish grey; yellow and ultramarine a yellowish grey, etc.

But if one doubles the quantity of the even colour, *i.e.*, in the proportion of one-third odd and two-thirds even colour, the perfect grey, corresponding to the mixture of white and black, is obtained.

Example.—

The complement of red	. . .	No. 1 is $1 + 3 = 4$, green.
„ „ orange	. . .	„ 2 „ $2 + 3 = 5$, blue.
„ „ yellow	. . .	„ 3 „ $3 + 3 = 6$, ultramarine.
„ „ green	. . .	„ 4 „ $4 - 3 = 1$, red.
„ „ blue	. . .	„ 5 „ $5 - 3 = 2$, orange.
„ „ ultramarine	. . .	„ 6 „ $6 - 3 = 3$, yellow.

To find the complement of an intermediate, we calculate in the same way as for the colours nearest to it, deducting from the found complement the same number of degrees.

Example.—To find the complement of crimson, we shall seek that of the nearest colour: this is red, of which the complement is green. As crimson is three degrees left of red, its complement will be three degrees left of green, *i.e.*, yellow-green; violet being three degrees right of

ultramarine, its complement will be three degrees right of the complement of ultramarine, which is yellow: it will therefore be yellow-green. The two extremes have thus for complement the fixed point—which is the centre. If we seek the complement of the red-orange shade placed at the first degree after red, we find it at the first degree after green, etc.

The Mixtures of Three Colours.

1. The mixture in equal parts of the consecutive colours, two odd and one even, produces the even one with less intensity of colour.

Example:—Red, orange, and yellow, produce a greyer orange than the normal orange, but also less grey than that produced by the mixture of red and yellow; yellow, green, and blue, produce a green greyer than normal green, but less so than that produced by the mixture of yellow and blue, etc.

2. The mixture, in equal parts, of three consecutive colours, two even and one odd, produces a grey approaching the odd colour.

Example:—Orange, yellow and green, produce a yellowish grey; green, blue and ultramarine, a bluish grey, etc.

3. The mixture, in equal parts, of three odd colours, produces perfect grey.

4. The mixture of three even colours produces also perfect grey.

As a matter of course, results obtained by mixtures of equal portions would be influenced by any colour the proportion of which was increased: thus, red and yellow, which in equal proportions produce orange, would produce a red-orange if the proportion of red were increased, and an orange-yellow if the proportion of yellow were increased.

As for all other combinations beyond those above specified, they give greys more or less coloured.

THE SUPERPOSITION OF COLOURS.

If we paint a transparent colour over so thin a white that this foundation white has influence, it is as if we were to put light behind that colour, which is then transmitted to us by *transparency* instead of by *diffuse reflection*, as when it is opaque. The effects obtained by the laying on of colours are more perfect in proportion as the colours used are more transparent. Leaving those which we have just used, as well as the black palette, we shall again copy the spectrum; but, this time, on a white palette and with colours which we shall render all equally transparent with more or less varnish, and leaving to them equally their colouring intensity. As for the luminous intensity—the light coming from below, produced by the white of the palette—it is perfectly regular for layers of similar thickness.

The first observation which strikes us is that by this new means we obtain a much greater colouring intensity for the same luminous intensity: *i.e.*, when, with opaque colours, we wish to have, for instance, a very light red, we must add to it so much white that we arrive at a pale pink where the sensation of red is almost lost, whilst, by transparency, we obtain at the same degree of light a pink much more vivid, in which the sensation of red is still palpable.

Another example still will help to show this difference.

Being given red the most intense possible to make with opaque colour, it would be useless to put more on the top,—it would not render it more intense; but if you painted it over with transparent red in glazing, you would increase considerably the colouring intensity without diminishing its luminous intensity.

Superposition of Transparent Colours on White and on Black.

A colour painted over white increases in luminous intensity in proportion to its being in coatings more or less thin; but it gets near to the fixed point of the spectrum (*i.e.* the yellow-green), according to the law that we have already mentioned.

*Example:—*In coatings thinner and thinner:

Left of the fixed point.	{ yellow becomes more and more yellow-green.			
	orange	"	"	yellow
	red	"	"	orange.
	crimson	"	"	red.
Right of the fixed point.	{ green becomes more and more yellow-green.			
	blue	"	"	green.
	ultramarine	"	"	blue.
	violet	"	"	ultramarine.

On the contrary, if you increase the thickness of the coatings, starting from the point where the colours are at their greatest degree of colouring intensity, they go farther away from the fixed point (*i.e.* of yellow-green), the luminous intensity diminishing.

*Example:—*In thicker and thicker coatings:

Left of the fixed point.	{ yellow becomes more and more orange.			
	orange	"	"	red.
	red	"	"	crimson.

And as after crimson is darkness it gets darker:

Right of the fixed point.	{ green becomes more and more blue.			
	blue	"	"	ultramarine.
	ultramarine	"	"	violet.

And violet, going also towards darkness, like crimson becomes darker. On black, if it were absolute, a trans-
 ... could not go. On account of its being

it can only transmit what comes behind it: so, if there be only darkness it can transmit nothing. But, as we mentioned before, there is in nature no body of an absolute black.

If we divide into a hundred parts the quantity of light which strikes a black screen, the screen reflects about five parts; yet this small quantity is sufficient to render perceptible the transparent colour painted on the screen: the effects therefore will be the same as upon white, but considerably darkened. In painting transparent colours upon lighter and lighter greys, you may see the results of this law accentuated in proportion as the gradations get lighter.

Superposition of Transparent Colours upon each other.

If you paint one transparent colour over another, there are mixtures by transparency and those mixtures follow the same laws as do the opaque colours. If the bottom colours be all white or black, you add to them the results which have been given by the superpositions on white and black that we have just been studying.

SUPERPOSITION OF TRANSLUCENT COLOURS.

Bodies composed of very small minute particles exist in suspension in a transparent gaseous medium either liquid or solid, such as clouds of dust and smoke, the gummy kind of paste, mother-of-pearl, opals, tortoiseshell, etc.; or composed of little imperceptible drops of liquid in suspension in a medium, also transparent liquid but of different density, such as all emulsions; or in a gaseous medium, like the vapours in the air—mist, dew, fog, etc.

These bodies, which are called translucent, uniting the properties of transparency and opacity, transmit a part of the light which they receive and reflect a part; but the part which they receive takes a more orange tint, and the part

which they reflect a bluer tint. Those two colours, orange and blue, of which tints the light, transmitted and reflected by the translucent bodies, is, are placed in the spectrum, just at the centre of each of the halves separated on the fixed point.

*Example :—*Smoke when escaping from the chimney of a hut appears bluish on the dark green of the trees, because, having no light behind to transmit, we only see the reflected light ; but the same smoke appears reddish when it is on the luminous sky. We see it then by transparency.

A glass of milk seen in transparency is orange ; but if you spill some of it on a dark table, it becomes bluish, because then we only see it by *reflection*.

The air itself, holding in suspension solid corpuscles, obeys this law of translucent bodies. The sky is blue, because, the terrestrial atmosphere, being unable to transmit the infinite darkness stretching beyond it, reflects the light of the sun. But turning aside, the atmosphere, transmitting to us its light by transparency, is no longer blue, and in proportion as the radiant orb descends towards the horizon its rays, coming through the translucent coatings of the mists which rise from the earth, are transmitted to us more and more orange as the mists are thicker and thicker, and quite at the approach of night, when the luminous intensity diminishes, orange, following the laws which we have explained, proceeds towards crimson, which is the last tint of the setting sun before darkness.

These are also the causes which make the sun appear like an enormous incandescent ball on foggy days.

In the same way can be explained the blue colour which the skin takes where the veins pass, the bluish tint of the white of the eye, etc.

Artists who, often without knowing the causes of Nature's phenomena, have yet observed them all, have for a long

time expressed instinctively this law of translucent bodies by separating their colours into two classes, warm tones and cold tones. Warm tones correspond to all that part of the spectrum left of the fixed point, whose centre is orange. Cold tones correspond to all the part right of the fixed point, whose centre is blue.

Painters speak the truth when they speak of the green leaves of plants lighted by transparency as of a warm green, and of those lighted from above as cold green.

Poets are not equally correct. Their famous phrases should be suppressed which speak of the golden sun of the South, the empurpled skies of the East, etc. On the contrary, the nearer the sun is to zenith the whiter its light is, and the farther you go to the regions of the South, the atmosphere there being less charged with vapours, the bluer is the sky and the paler and more intense the light. We must go to the North, to the countries of fogs, to find the warm colouring, the golden reflections and the purple rays.

Besides, it is in those northern places—in Holland, in Flanders, in England, at Paris—that the greatest colourists have lived. In Italy they are much fewer, except at Venice, which is a misty place. If we go thence south-eastward we do not even find great artists.

If you add to the material opaque colours a transparent liquid, such as varnish, or if you use them in thin coatings, you render them translucid and they produce the results we have just been describing. Rubbed on dark tones, they approach blue and become colder; rubbed on light tones, they approach orange and become warmer.

A colour altogether opaque should have no transparency, even in the thinnest coatings; and a transparent colour should always remain so, even in a very thick coating. Now, as neither absolute transparency nor absolute opacity

exist in nature, and as oil and similar necessary mediums render paints more or less translucent, the opacity which we obtain from them is only relative, and it is by the degree of thickness of the coating that we render this quality perceptible. As for transparency, we can, by the help of varnish, arrive more completely at it; but to light our opaque colours in front and our transparent colours behind, we have not the command of light at the greatest degree of intensity which it displays in nature.

To light a white canvas by the sun we must content ourselves with the diffuse light of a studio or museum reflected by our oil-white, or our paper if it be water-colours that we are using; and this white absorbs already much light, for it only reflects 40 per cent. of what it receives.

To represent a pane of stained glass transparently lighted by the sun, as our back-light we are obliged always to use those same feeble whites. In the matter of darkness we are also limited, having only black, which reflects 5 per cent. of the light which it receives, and which consequently is already grey in comparison to an absolutely dark hole. Yet if painters of talent arrive at giving us truthful representations with those limited means, it is only by using artifices—by exaggerating opposites, by sacrificing certain points and making much of others—that they succeed. In fact, that is the art of painting, and the art is not to be learnt in a book; but what is to be learnt there is the use of the contrast of colours, which may be made very profitable.

THE CONTRAST OF COLOURS BY JUXTAPOSITION.

Contrast of Black and White.

White, placed beside black, makes the latter appear blacker and itself whiter; but this effect is produced more

and more strongly the nearer the two are brought together. Consequently, when a white band and a black one touch each other, the part of the white band which limits the black, seeming whiter than the rest of the band, the white stripe appears shaded like a white stick; in the same way the part of the black band which limits the white, seeming blacker than the rest, the black stripe has the effect of a black stick. A succession of grey and white bands alternately side by side would give the impression of a fluted pilaster. This, applicable to all colours which are of different luminous intensities, will produce each time only two tones, containing each more or less white or black than the other.

Contrast of Colours in Juxtaposition.

1. When two colours which follow each other in the order of the spectrum are placed side by side, they take more and more, in proportion as they approach each other, the aspect of the colour which precedes or follows them.

Example:—Red and orange: the red which verges on orange approaches the crimson colour which precedes it; the orange which verges on red approaches the yellow colour which follows it. Yellow beside green becomes more orange; green beside yellow more blue; blue beside ultramarine becomes greener; ultramarine beside blue more violet; violet beside crimson more ultramarine; crimson beside violet redder, etc.

2. When two colours separated by another in the order of the spectrum are in juxtaposition, the same results are obtained.

Example:—Red beside yellow becomes more crimson; yellow beside red greener, etc.

3. When two colours are separated by two others in the order of the spectrum they are, as has been said, complementary; then they do not change when in juxtaposition, but they intensify.

*Example:—*Red beside green increases in intensity—it becomes a brighter red; green beside red appears a brighter green, as do all the colours with their complements.

4. When two colours separated by more than two others in the order of the spectrum are in juxtaposition, each approaches the complement of the other.

Example:—Red and blue. Red beside blue verges on orange, complementary to blue it becomes more orange; blue beside red verges on green, complementary to red it becomes greener. *Red and ultramarine.*—Red beside ultramarine verges on yellow, complementary to ultramarine it becomes more orange; ultramarine beside blue verges on green, complementary to red it becomes bluer. *Orange and ultramarine.* Orange beside ultramarine verges on yellow, complementary to ultramarine it becomes yellower; ultramarine beside orange verges on blue, complementary to orange it becomes bluer, etc.

After these explanations, it is easy to understand how the aspect of a colour may be modified without changing it.

When you have exhausted all the resources of the palette to make a colour intense, you can still increase its brilliancy by cleverly surrounding it with objects of its complementary colour; if, on the contrary, you find that a colour is too pronounced, you can soften it by surrounding it with objects of the same colour, more intense.

*Example:—*An orange drapery can be rendered yet more orange surrounded by blue tones; a red surrounded by green tones will seem redder, etc. A portrait may have carnations that one thinks rather too red, but does not want to change.

The normal aspect may be given by a red background : if it is too pale it will become pinker with a green background, etc.

Nature has at its disposal luminous and colouring intensities which we have not on our palette. We are therefore obliged, in order to imitate the phenomena produced by nature, to exaggerate them. It is therefore necessary to know them.

Let us resume our former example, where we saw that the smoke of a hut appeared bluish on the dark background of trees, and reddish on the sky. If, after having painted the trees and the sky, we take the uniform tone to represent smoke, we shall not obtain the same result as in nature. Our sky has not the luminous intensity of the real one, and to give the appearance of it we have exaggerated the darkness of the trees; we must therefore also exaggerate the blue tone of the smoke when passing over the trees, and its orange tone on the sky.

If we paint this smoke according to nature, we shall make this exaggeration instinctively; but if the hut does not smoke that particular day, and we do not know these laws, it is more than probable that we shall carefully paint a smoke false in tone.

Finally, what we wish to have understood is, that a knowledge of the laws of colouring facilitates the work of the artist, by enabling him to give reasons for the causes which produce the different effects that are made by colours in nature, in the same way that drawing becomes easier when perspective and anatomy are known.

CHAPTER IV.

WITH THE SCIENTISTS.

THE laws of colouring, as they have been formulated in the preceding chapter, unite almost all the results made by discoveries up to the present, but presented in a form especially suitable for artists; for men of science have been more inclined to the study of the coloured rays than to the study of concrete colours.

This theory, therefore, has nothing new but the form in which it is presented. Rule without exception, and universally demonstrated, universally controlled and recognised, it is at last the truth.

To explain the reason of it is quite another matter. Learned men are not agreed upon this subject, and when "doctors differ" the majority of people find it difficult to form an opinion.

The best thing would be to wait, but artists are impatient to know what is hidden at the bottom of this mystery - all the more so that we are enticed by treatises on harmony of colours by following which every one can (at least so they are promised in the prefaces) instantly become a great colourist. This is very tempting. If therefore any one is on the point of plunging into the furnace, let him first listen to this.

A young artist, anxious to know the reason of everything, prowled unceasingly round the domain of science, that he

grove where the pontiff scientists hide from profane eyes the secrets they discover from nature. One day the young man, flushed by penetrating into the mysterious sanctuary, yellers a tall old man with a keen and cunning look immediately came to him. This grave personage carried over his shoulders keins of wool of all shades, and in the other hand he held a disc, divided like a cake into parts of all the colours of the rainbow. He spoke in a loud voice: "Young man, the senior student, to-day a centenarian, welcomes you, and knowing the object of your visit, he congratulates you on having found immediately the best method from you could follow. My system is marvellous: it explains everything; it replaces everything. No more of the complicated names by which colours have been named: we shall have no more turtledove grey, nymph pink, dead-leaf, or Dauphin brown; but for example, in such a case, the eighth tone of the reduced yellow scale, seventh, eighth or ninth shade, according to whether the Dauphin brown is more or less green."

"Yes," thought the young man.

"And see how simple it is," continued the old man, showing his disc. "Do you seek the complement of a colour? Exactly opposite, following the diameter,—no more possible; obligatory harmony for everything.

"I regulate the toilet of ladies, military uniforms, the arrangement of gardens and salads; I regenerate the art of the upholsterer, of the glazier, of the artist, and of the decorator."

"After this chromatic circle is a work of genius. And you, my young man, that in writing on these subjects a volume of 350 pages, I have done nothing lightly. I tell you so in my preface. I have submitted each experiment to my pupils, to my friends; and it is not the judgment of

my own eyes that I have written, but the average judgment of many."

"Pardon," insinuated the young artist; "you appear to confess by that, that your arrangements of colours may present different effects to different people, in which case your universal system would cease."

"One moment, young man. Do not try to make me say what I think; at my age we don't do that. It must be admitted that my system is applicable to every one, without that it would be useful to no one. The hypothesis on which it is constructed, of three simple colours, *red*, *yellow*, and *blue*; and of three colours compound by the mixtures of simple colours, *orange*, *green*, and *violet*; otherwise, I could not divide my circle into corresponding parts: nothing would harmonise; there would be confusion and a mess—if you prefer a mess."

"No! no! only you are suppressing one of the colours of the spectrum."

"Which, please?"

"Well, ultramarine, it seems to me."

"You say ultramarine? Yes, what in my time was called indigo: you see it has even changed its name. It is not really a colour. It is a spurious mixture of blue and violet, the favourite of laundresses, in any case worse than useless, an intruder, a hindrance. No, but do you see it in my circle? It prevents it from being perfectly round. As well put up my disc at once, and restore the Gobelin to Louis XIV." The noble old man, going away visibly ruffled, exclaimed these last words: "Presumptuous young man, from the moment that you defend indigo, you may choose another guide."

In fact, the young artist, turning round, found himself before two other personages.

"I present to you the celebrated Thomas Young, the pioneer whom I am proud to have followed," said one of the two, introducing his colleague; "the first half of our common glory."

"And I," said the other, "present to you in my turn the celebrated Helmholtz, my worthy successor, the second half.—Well, young man, then you do not adopt the hypothesis of that obstinate old man?"

"Our system," continued the celebrated Thomas, "explains everything, replaces everything! Our three fundamental colours——"

"Ah! you have also three colours?"

"Yes, but they are not the same: ours are red, green, and violet. We suppose the retina to be composed of nervous rootlets united in threes, and we suppose that each of the three is sensible of one of our three colours."

"Ah! you suppose also!" sighed the young artist.

But the "worthy successor," understanding the thought, added diplomatically: "Remark that Thomas had made those suppositions long ago; I had, therefore, nothing to suppose when I presented that theory whose glory we share. After reading our works you will be doubly convinced." And the two men of learning took leave of the young artist, each cordially pressing one of his hands.

The apprentice of learning, somewhat discouraged at this beginning, sought no more guides, and decided to penetrate the mysterious labyrinth alone, listening here and there, sometimes to the pleadings of David Brewster, the intrepid defender of the three primary colours, and of J. J. Muller and Maxwell, Thomas Young's disciples; sometimes new theories about the retina containing three visual substances with r, x fundamental sensations, or even the theory of the waves producing on the retina different compounds according

to their length; sometimes also, the fantastic lucubrations of demented brains, rules of music applied to painting, chromatic pitch, chromometer, etc. Even the lamentations of the forgotten and ignored, such as Wörnst, who professes to be the discoverer of Young's theory, and poor Newton who cannot forgive the theft of his disc: "I invented it first," he often said with bitterness; only I made no flourishes to attract loungers!"

In short, when our young artist came out of this domain of science, his hair was grey, and he was more than fifty years old. Common Sense was awaiting him at the door.

"You are here at last!" cried he (Common Sense is a companion of childhood that we often lose sight of in life, but who always considers us children). "Have you, at last, adopted a system?"

"No."

"So much the better!"

"Yes, but I have made one!"

"So much the worse!"

"Oh! don't laugh: my system is admirable; it explains everything, it replaces everything. Here is the principle: bodies, whatever they may be, absorb the light which they receive, up to a point variable in each body, when they become saturated with light; then only they begin to decompose it in a certain proportion still variable, and at last, when they can neither absorb nor decompose any more light, they send it back with the coloured rays which they have not absorbed."

"Very good! that is no worse than anything else; but are you quite sure about it?"

"Well! I suppose it: if my hypothesis be not admitted, my system no longer exists."

Then Common Sense began to laugh—a laugh terrible to hear.

“How?” he resumed: “you find all systems bad because they rest upon suppositions, and in order to replace them you invent one more, also a supposition. It is time to beware of that!”

“Then, if my system is not good, what am I to say to my colleagues, who are simple enough to expect my revelations?”

“The truth.”

“The truth! Am I then to tell them that, in harmony of colours, there is no absolute rule?”

“Exactly so.”

“That beyond the elementary laws of colours, there is nothing we can apply in all the theories known up till now?”

“Yes.”

“That artists should only take advice from nature, and, the better to understand it, should study the manner in which the great masters have interpreted it?”

“Wonderful!”

“Then, they must be told also that there were magicians called Veronese, Rubens, Delacroix, and many others, who knew more about colouring than any scientist in the world; for with their colours they have created a language which speaks to the soul, which communicates feeling and life, long before science has even suspected that coloured rays influenced the brain.”

“Bravo! That really is the truth!”

“If this be the case, as well as immediately confessing to my colleagues that I thought to astonish them by my learning, I must tell them that all I bring back from my journey to the scientists is limited to this advice; Don’t do as I have done, don’t lose your time in seeking that which does not exist!”

“Well! but acknowledge it without blushing—at your age one may still acknowledge—this advice will be valuable, should it serve to spare others the worry you have given yourself, and that will restore a little the inflation of pedantry of which I have just seen you deprived. The pedant, do you see, is detestable because he lacks charity. He thinks in his vain egotism: ‘I have grown pale over volumes, I have searched dictionaries, I have scrawled notes, I have dissected, analysed, and that for years, to discover something; and this something, I would go to tell in two words to others, who would thus know it without trouble. Ah! no, let them learn first to understand the noble phraseology of science, for I do not speak a language comprehensible to the vulgar crowd: I call a colour a pigment; a paper horn a spiral cone; and the good God, Lord Archetype or Demogorgon! Afterwards the converts will swallow my prefaces, the recital of my unsuccessful theories, my refutations to my adversaries.

“‘I will present problems without giving the solutions, of them, I will develop hypotheses which I shall afterwards destroy, I will scatter Latin and Greek quotations without translation, archæological notes supported by documents, etc., etc., and the useful substance I shall only give out little by little, bits at a time. If I ever see a colleague engaged in a search which I have followed, and which leads to nothing, I will let him have his turn at it, let him get embarrassed as I did, let him wander as I wandered, even if he should perish where I was able to pass. Ah! but it would be too convenient then; they would only have to fold their arms, and to assimilate science from others without seeking it themselves!’ Dull pedant! you can never be covered with enough contempt; but with how much respect, honour, and love, may be hallowed the memory of these

true scientists who work throughout their lifetime in order to leave to the world a single phrase which may be written in the book of human science !

“ But you make me forget my duties,” cried Common Sense, interrupting himself ; “ to-day I must preside at an assembly of artists ; I have been absent from those assemblies several times,—they will begin to think that I don’t wish to appear there any more.” And he went away. Let us hope that we shall meet him again !

CHAPTER V.

COLOURING SUBSTANCES.

IN taking, to determine the laws of colouring, the compounds of colouring-matter which may best represent the free colours of the *solar spectrum*, we have made a theoretic palette ; but the exclusive use of that palette would not be practicable for painting.

In the first place, the substances which compose them are not all solid, and some of their mixtures would produce chemical reaction capable of changing them. Further, those colours are not found ready made, and their manufacture, which could scarcely be counted upon with absolute certainty, would be expensive.

Then why should we deprive ourselves of earths, ochres and marls which are quite sufficient for broken tones frequently wanted, and which join to a perfect fixedness the precious qualities of covering well and of drying easily ?

Do not let us banish, from prejudice, any colouring-matter from our palette ; for, as M. de la Palisse might have said, "All that can be used are useful," always provided that they are substantial, and that is what we have now to consider.

Ancient artists, in the time of Apelles, had only four colours : chalk white, yellow ochre, red ochre, black.

Are we quite sure of that ? Pliny, who came some centuries later, affirms it, and he tells us further that in his time painting was already enriched by a large number of new

colouring-matters, whose nomenclature is here re-established in modern language:—

Chalk white, variously produced. White lead, and its derivatives.

Massicot and minium orpiment (sulphur of arsenic, red, and yellow).

Red lac—lakes of purple colours, prepared from shell-marl.

Natural and burnt ochres.

Cinnabar (native vermillion).

Indigo.

Blue pulverised enamels.

Verdigris.

Brown earths.

Various blacks prepared from the combustion of different bodies, *e.g.*, ivory, grapestone, etc.

Sepia.

And Pliny laments this profusion of colours, regretting the time when there were only four of them. He cries: "To-day, when purple even covers our walls, when India procures to us the coloured sand from its rivers and colours drawn from the blood of its dragons and its elephants, we have no longer noble paintings. Then, when we were poorer in materials, we really were richer in art. It is no longer soul that one paints, it is the luxury of personages. It is the material that is now appreciated in art."

Were it not that we know that Pliny wrote that more than eighteen hundred years ago, we might believe that we were reading an article of yesterday. Yes! if art be always young, we may say that criticism has always been old.

In spite of Pliny, the domain of painting continued to increase.

Means of preparing yellow lakes from buckthorn, and red lakes from cochineal and certain woods, and finally madder, were discovered after his time.

For blue lapis was used, and the palette was enriched by new terre-vertes and browns.

However, chemistry did not yet exist. Painters, confined to the productions of nature, cared only to procure them as pure as possible.

In a barn of Antwerp Museum there exists a trunk which belonged to Rubens, carefully preserved, and in which he had stored away collections of pigments gathered during his travels. Besides the inestimable value attached to this souvenir of the artist, this trunk is for us a valuable lesson. One learns by it the personal trouble which the great artists took in selecting their pigments, and the authentic specimens this trunk contains permit us to learn exactly the materials with which the pictures we so much admire to-day were painted, and to choose amongst them those which are best preserved.

White lead, cinnabar (native vermilion), lapis, charcoals, madder lakes, earths and ochres have resisted very well ; but buckthorn, like all yellows, reds and vegetable greens, has more or less disappeared. Those results should be noted.

Since the time of Rubens, many new colours have been invented, and science constantly furnishes new ones ; unfortunately more attention is bestowed upon their brilliancy than upon their solidity.

The discovery of aniline amongst others has been quite a catastrophe for art.

It is true that as soon as a colour is reputed bad, conscientious artists dismiss it from their palette ; but it quickly reappears disguised, like swindlers who change their name to make new dupes, and it becomes very difficult to recognise those bad materials in the clever mixtures in which they are concealed.

So, from fear of being deceived, certain artists fall into an excess of distrust which prevents them from using new productions that they might safely employ.

Without knowing enough of chemistry, they know too much of it and take fright at certain names. Thus, knowing the misdeeds of chrome yellow, they hesitate to use oxide of chrome (emerald-green), one of the best colours existing, because they do not know that the most terrible substances may become inoffensive when they are mixed. For example, pour into one glass some muriatic acid and into another glass a concentrated solution of caustic soda; then, into each of those glasses throw little pieces of meat: they will be instantly dissolved under your eyes. Then, mix the contents of the two glasses by pouring the one into the other and—swallow the whole! It will taste just like a glass of sea-water, nothing more. Those two rightful corrosives are transformed into chloride of sodium, which is merely common kitchen salt. Chlorine is another substance that one is still desirous to see amongst pigments, for everybody knows it destroys almost all other substances. When it is alone, yes!—but with others it is often perfect,—like a policeman, implacable in uniform, but tender and gentle in the bosom of his family.

It will therefore be preferable, instead of studying pigments separately under names which are not real, and allowing ourselves to be guided by prejudices accompanying these names, to group the pigments according to their derivation, and to consider their general qualities and faults.

We can thus establish five categories of colours:

<i>First Category:</i>	Vegetable colours.
<i>Second</i> „	Animal „
<i>Third</i> „	Mineral „
<i>Fourth</i> „	Colours obtained by vegetable and mineral combinations.
<i>Fifth</i> „	Charcoals.

The *first category* includes coloured substances procured

directly from vegetables, fresh, dried or torrefied, such as iris green, chicory brown, coffee brown, indigo, gamboge, saffron yellow, etc. All the colours of this category are bad: they fade from exposure to light, some of them change tone on contact with fat bodies, and others are frequently destroyed by mineral combinations with which they are mixed.

The *second category* includes coloured matter procured from animal substances, such as purple, Indian yellow, carmine of cochineal, sepia, etc.

Purple, which was produced from shell-marl, is now only known by name, and the recipe for its manufacture is lost; but now a similar product is obtained from the purpurate of ammonia obtained from uric acid.

It is said that Indian yellow is obtained from the excrement of the chamois or of cows fed on certain plants; in any case it is a very alkaline substance, which changes oil into soap, and may become, consequently, soluble in water, if the grinding is not carefully done.

Carmine fades in light.

Sepia is solid in water-colours, but does not grind well with oil.

The *third category* includes all combinations of metallic bases, whether natural or obtained by chemical processes; some are to be found in a free state, like carbonate of lead (white lead) and sulphide of mercury (cinnabar), whilst others are more or less firmly fixed in coatings of clay to form the coloured earths to which we give the name of ochres, or in silicious matters to form stones like malachite and lapis.

All these mineral colours are generally solid, but they are not of a good homogeneous tone; and although after being powdered, they may be washed with great care, one can

never quite succeed in getting rid of the impurities which they contain. This is detrimental to their brilliancy.

It will be understood, therefore, that in re-making by the aid of chemistry the same combinations met with in nature, and by establishing them on pure and uncoloured substances like aluminum and silica, which are the bases of natural clays, we obtain those same colours quite as solid and much more beautiful. It is thus that marls reproduce all the red and yellow earths coloured by oxide of iron, and that Guimet ultramarine is the reconstitution of lapis-lazuli as vermilion is that of cinnabar.

Chemistry does not merely confine itself to reproducing combinations which may be found in a natural state; chemistry has already given us many others, and it is to be hoped that it will continue to enrich this category of mineral colours to which it has already added so much precious matter. It is true that on the other hand it has given us some useless and even bad, which we must be careful not to use: we shall therefore devote a chapter to the practical means of recognising them under whatever name they may be called, and in whatever mixture they may be introduced.*

The *fourth category* includes all vegetable and mineral combinations whose principle consists of fixing on aluminum or silica vegetable dyes dissolved in water by means of precipitation.

In this way are obtained red lakes, with dyes of madder, Brazilian wood, Pernambuco wood, Campeachy wood, etc., and the yellow lakes with dyes of woad, Avignon berries, buckthorn, etc. These last often bear the primitive name of *stîl de grain*.

All the colours of this category are bad; they fade in the light, and are changed by contact with certain mineral

* See APPENDIX—"Verification of Colours."

colours ; they should not be used. We must here, however, except the madder lakes, which are comparatively solid, and which are indispensable, because we have no others. Besides, by taking certain precautions, we can minimise the inconveniences. As for yellow lake, it can be advantageously replaced by iron lake, which, in spite of the diffidence natural to an inventor, we recommend as being of perfect solidity.

The *fifth category* includes charcoals produced by the calcination of certain vegetable or animal matter, such as peach kernels, wood, cork, vine shoots, chestnuts, ivory, bones, etc.

This category furnishes only blacks, all of which are good.

We have only to reject bistre and lampblack, which are bad on account of the tarry matters contained in them.*

Bitumen, which we have not classed with mineral colours, will not find place with charcoal either, for it must be formally excluded from painting. It is the plague, the death of pictures. It never dries thoroughly, or at least it softens and runs as soon as the temperature rises above 30° to 35° per cent. By mixing it with a very siccative oil, you may give it an appearance of solidity, but, sooner or later, it is certain to run and exude from the canvas. It is all the more destructive for being used to prepare foundations ; and pictures thus painted upon foundations which are always soft, must, of necessity, crack.

To give examples caused by ravages owing to the use of bitumen, it is sufficient to refer to the canvases in our museums which it has already been necessary to restore several times, such as the "Shipwreck of the Medusa," by Géricault, the "Portrait of Cherubini," by Ingres, and so many others, alas !

* It is possible by careful preparation to get a lampblack free from tar.

But the fanatic lovers of bitumen answer you : "That is not the fault of bitumen, it is the manner in which it is used." Here, then, is another example. A well-known picture dealer, who is also an intelligent collector, has succeeded in collecting a large number of palettes which had belonged to artists of renown. These palettes were taken after the day's work of the artist was over, and not only were they covered with the pigments used, arranged in the order habitual to the artist, but they still showed all the tones improvised whilst actually painting, and on many of them the artist had painted a little bit, according to his own method. We have thus many specimens of almost all the methods in which bitumen can be used. Those palettes as well as pictures are hung on the wall. They are taken good care of, as you may suppose, and even if they are subject to sudden changes of temperature, those changes are common to all. Well ! all the palettes having no bitumen are in perfect condition, exactly as they were left by the artists ; but in all cases where bitumen has been used, the bitumen has run ; not merely the small quantity arranged in its place with the other colours, but also the tones mixed with it. Is this conclusive ? At least the bitumen enthusiasts cannot pretend that no artist knows how to use bitumen. This unique collection will be bequeathed by its proprietor to the Louvre Museum, and it will be a great lesson for the future.

Some artists pretend to have substantial bitumen ; they either deceive themselves, or are deceived. Colourmen give them a false bitumen made with yellow lakes and aniline black. Those false bitumens fade in the light. Real bitumen also fades.

However, if bitumen is essential to certain artists, it is quite possible for them to make a bitumen with substantial pigments united with normal resin soluble in oil, and

not melting at a low temperature. This imitation bitumen will have all the qualities of the real bitumen in the way of convenience, and will not have its disadvantages.* It will have the additional advantage of not fading in light. As for mummy-umber, that is still bitumen, and the few particles of Pharaoh which it may contain must not induce us to accept it.

We give (APPENDIX—"Good and Bad Colours") detailed explanations on good and bad colours; but for those whom these details may tire, here is the list of the colours which may be used with perfect certainty:—

- White lead (carbonate of lead).
- Zinc white (oxide of zinc).
- Cadmium yellows (sulphide of cadmium).
- Strontia yellow (chromate of strontia).
- Zinc yellow (chromate of zinc).
- Iron lake (oxide of iron on aluminium basis).
- Vermilion (sulphide of mercury).
- Madder lakes (madder dye on aluminium basis).
- Cobalt blue (oxide of cobalt on aluminium basis).
- Emerald green (oxide of chrome).
- Mineral violet (phosphate of manganese).
- Cobalt violet (phosphate of cobalt).

Further, all the natural and burnt ochres; all natural and burnt earths having oxide of iron for basis, are equally good, as well as all the marl colours, which are oxide of iron at different degrees of calcination on aluminium basis. As for blacks, they are all good except lampblack, containing some tarry matters.

From this list we exclude all colours on lead bases, such as chrome yellows (chromate of lead), Naples and antimony yellows, massicot and minium, which are white lead more or less calcined, because those metallic combinations are liable

* See APPENDIX—"Brown Colours."

to get black when brought in contact with the air, and they may be replaced by others ; still they may be used if certain precautions are taken, and also Veronese green and certain other colours. (See APPENDIX—"Yellow and Orange Colours.")

If we have not rejected white lead itself, it is because there is no equivalent for it known up till now : its covering and drying qualities, and the hardness which oil imparts to it, make it indispensable. Still it is very dangerous to use it with sulphides such as vermilion and cadmiums, with which we consider nothing but zinc white should be mixed. For cadmiums this precaution is useless if they are well manufactured.

This question of the chemical solidity of colouring-matters is excellent for the preservation of painting ; unfortunately artists will never give it their personal attention ; many of them will not even read the chapter in which we shall give precautions to be taken for the manufacture of pigments and their use, as well as the practical means of analysing them. (See APPENDIX—"Good and Bad Colours.")

Colourmen should therefore be forced to furnish good materials, and here is a means which we consider excellent for obtaining this result.

Artists should insist, when they buy a tube of colour, that the ticket bears, in addition to the usual name of the colour, its chemical formula according to the above list.

In this way, if the colourman does not furnish what he professes, he can be summoned for fraud ; there is deception about the quality of the merchandise. Whereas now we cannot even complain, because the names Capucin lake, Geranium lake, China rose, given to all sorts of concoctions, profess nothing, any more than golden yellow, malachite green, Venetian red, etc.

For instance, you buy a tube of celestial blue : this blue is made of Prussian blue, or of anything else ; it is of no consequence to anybody ; the colourman may call anything he pleases celestial blue. You evidently consider it sufficiently celestial since you have taken it. Yet if artists, seeing that this celestial blue is not substantial, should cease to ask for any more of it, it would discard its name and reappear, with more or less white, under the names of azure blue, peacock blue, turquoise blue, sapphire blue, Smyrna blue, etc. We are still far from having exhausted all the names of precious stones, flowers, towns, birds, of which the colourmen's vocabulary is composed ; and if the reform which we propose should have no further result than to render useless all these fantastic appellations, it would even then do good service, for the number goes on increasing in ridiculous proportions. If we do not stop soon, there will be thousands of those new shades, which are, as a rule, merely common pigments of bad quality dyed and done up with aniline products, all fading in the light.

From a technical point of view, it is also puzzling if different people give to the same thing different names, or the same name to different substances. Thus, an author in whom you have every confidence asserts to you that vermilion is solid ; you therefore make use of it, but instead of the sulphide of mercury recommended to you, it is iodide of mercury or dyed minium or anything given to you under this name of vermilion : not merely do they sell to you at the rate of 15 francs what is worth 40 sous ; but they compromise your work. It is a swindle and an abuse of confidence, which could not occur if you bought your colours under their true names. Ask a druggist for an anti-fever powder, and he may give you a little lentil flour sweetened ; but if you ask for sulphate of quinine, he is obliged to give you some, as

the colourman will be forced to give you whatever may be stated by the ticket on his tubes. But, some one will say, this colourman is himself deceived, for often he does not manufacture the colours he sells. In that case, when buying his primary materials, let him exact from his furnishers the guarantees which his customer requires from him, and you may be sure, should the subject ever be one for litigation, he will know how to make the true perpetrator of the fraud responsible.

The only serious objection which could be brought against it is this : you cannot force colourmen to make their tickets as you ask. That is true, but neither can you force artists to buy there rather than elsewhere ; and it will be enough for one colourman to begin, for all the others to be obliged to do as much under penalty of losing their customers, for to refuse to give the guarantees given by a colleague would be to confess intentions of inveterate fraud.

Further, this guarantee of chemical formulas, which might be immediately obtained, is not the only one which we might ask : in a future perhaps nearer than we think, we shall have many more guarantees, and if the project which we have submitted to the "Society of French Artists" is accepted, the members will no longer have anything to desire with regard to the purity and good fabrication of the productions they require.

This is the style of project :—

1. That a permanent commission on the material processes of the arts should be named by the committee. It would be composed of members of the society—artists, sculptors, engravers and architects ; whilst all branches of art having, from a practical point of view, problems to solve and advantages to draw from the work of this commission, are interested in being there represented.

Members foreign to the "Society of French Artists"—chemists, manufacturers, etc., whom their capabilities would render useful—could be added to the commission by a temporary or definite title.

The duty of this commission would be to study all inventions and all processes, both ancient and modern, and to indicate, in special reports, those which might seem to them preferable ; to receive and to class communications made to them ; to reply to questions which might be addressed to them ; in short, to centralise all that might be said or written on the matter.

The commission would have the power of preparing all treaties and conventions with manufacturers and dealers in products destined for the arts, which treaties and agreements would not bind the society until after having been regularly accepted by the committee.

2. There should be added to the monthly bulletin of the society a rubric the direction of which should belong exclusively to the said commission, who might introduce into it all communications, correspondence, articles scientific or otherwise (even when emanating from collaborators foreign to the society), should their publication be found useful.

3. There should be founded a laboratory where the society would maintain a chemist charged with studying the questions submitted by the said commission, and with making all analyses required by the artists, manufacturers or dealers. The analyses might be charged at prices which would enable the society to refund its expenses.

4. The treaties between the society and the dealers or manufacturers should be made upon the largest possible bases—*i.e.*, the society would grant no monopoly to any one, and would exclude no one. The society would be satisfied, abandoning all idea of commerce on its own account, to

authorise absolutely without fee the said dealers and manufacturers to put a mark determined by the society and belonging to it, upon those of their products which the society had recognised as good, after the decisions of the said commission on the material processes.

Each dealer or manufacturer, on depositing the sample of the product which he desired to have stamped, would bind himself in writing, under penalty of a heavy fine in case of non-fulfilment, to manufacture always a product identical with the sample, which would be guarded under double seal to bring forward as a proof should litigation ever become necessary.

Artists, being afterwards informed that the products stamped by the society are guaranteed of pure matter, of good manufacture, and in no way injurious to the preservation of their works, will have the right, it will even become their duty, to insist that their furnishers submit their goods to this stamp, as it will be refused to no deserving person. Let no one say that this project of treaty with manufacturers is a chimera; for we can name already the house of Lefranc & Co., which is quite disposed to be the first to sign.

As for the necessity of assuring the greatest possible durability to our works, some critics sneer at this as at a ridiculous pretension, and some artists, through false modesty, consider it may be neglected; but we are of opinion that it is only honest, and that honesty in everything is the best policy.

In fact, as we sell our pictures, we make of them merchandise, and all merchandise which deteriorates and loses its value in the hands of the acquirer is soon discredited,—all the more so that to-day the prices at which amateurs acquire works of art give them the right to be exacting.

In letting it be supposed that modern painting can be

unsubstantial, it is not only to ourselves that we should be doing wrong, it would be also to our successors. Yet it must be so. But as we cannot know what the future alone can demonstrate, it is well to let the fastidious care which we take be known, and also the guarantees with which we surround ourselves in the choice of the materials that we use.

CHAPTER VI.

OILS, GRINDING OF COLOURS, ESSENCES AND SICCATIVES.

THE colouring-matters being chosen, and offering the best guarantees of solidity, we have now only to grind them with an agglutinative of some kind, so that, reduced to the smallest possible particles, they may be in a condition suitable for whatever style of painting they are destined.

We shall speak of gums, wax and other agglutinative substances used for this purpose when we shall study the different processes of wall-painting, water colours, distemper painting, pastel, etc.

For the present, we shall only consider oil painting, which, being the furthest developed and the most generally used, is entitled to the first place.

OILS.

The name of oil has been given to many liquids which are neither of the same composition nor possessing the same properties.

1. *The essential oils* are extracted by distillation, from certain plants, such as rosemary, lavender, fennel, etc., or from certain resinous balms, such as turpentine. Some are also obtained merely by pressure, like the essential oil of lemon. Now the name of essential oil is fallen into disuse; those products in general are called essences. Essences dry by evaporation, but they leave a residue more or less

viscous ; some are used in painting, and we shall notice them later.

2. *Empyreumatic oils* are produced by the analysis of certain bodies by heat, such as oil of wax, oil of camphor, etc. Nearly all the resins burnt emit vapours which condense into empyreumatic oils. Bistre and certain tars are empyreumatic oil of wood mixed with charcoal. These oils also dry by evaporation, but very slowly, and they leave yet more viscous residue than the essences; so they are not used, except oil of wax, an attempt to utilise which was made about 1830, but in a kind of encaustic painting with a basis of wax and resin: the author who speaks of it merely advises timidly the trial of it with oil paints.

3. *Animal oils* are obtained chiefly by boiling the feet and hocks of animals, such as neat's-foot oil, sheep's-foot oil, etc., and they are also found in a natural condition under the skin of certain fish, such as whale oil. They are not siccative, and are of no use for painting. An oil is also prepared from eggs, either by pressing the yolks hardened in boiling water, or by putting the yolks into sulphuric ether, which dissolves the oil, that is afterwards collected when the ether evaporates. This egg oil is not yet of any use ; but it is well to know of it, because it is certainly one of the principles of egg-painting, so much used formerly, and which has given such substantial results. This oil does not corrupt, like other animal oils, and perfectly dissolves cold resins, with which it forms varnishes comparatively hard at the end of some time, although used alone it is not siccative.

It is not in short used ; but perhaps some day it will be.

4. *Fixed oils* are procured by means of pressure from different vegetable matters which contain them. They are not all suitable for painting, and some are not siccative—such as olive oil, for instance.

Those which dry present a peculiarity distinguishing them from essential and empyreumatic oils; they do not evaporate, on the contrary they increase in weight by drying, and this increase is due to the quantity of oxygen they absorb; but, whilst increasing in weight, they diminish in volume. In fact, if you put a certain thickness of oil into a plate, at the end of some time a pellicle is formed whose surface remains perfectly soft. Yet when the oil gets thoroughly dried the surface is lined, because the fresh oil, shut under the pellicle as under a skin, coming to dry in its turn and diminishing in volume, the same phenomenon is produced as when a balloon gets disinflated or a person gets thin, the skin becomes too large and forms folds.

The term "to dry," applied to oil which passes from a liquid to a solid state is not appropriate, as nothing evaporates—quite the contrary. In reality, there is condensation and absorption of oxygen; but what happens with this oxygen? Is there a combination? Is a new body formed? In any case the solidified oil no longer dissolves in any of the solvents of fresh oil, except benzine. And, on the contrary, the alcohols which do not dissolve fresh oil dissolve dry oil.

There has therefore been at least a serious modification in the nature of the oil to produce such great differences.

Amongst the oils now used for painting there are two which are generally preferred: linseed oil, and poppy oil.

Linseed oil is the more siccative of the two; it acquires greater hardness and remains more transparent whilst drying than poppy oil; but it is more viscous and gets more easily sour. In this last case, chemical combinations operate in the tubes with certain colours, especially those having an aluminium basis—such as lakes, for instance, which become like india-rubber. It is said of pigments arrived at this

condition that they are greasy, and can only be used when diluted with oil or essence; but they should not be used. They should be entirely discarded, because they will never dry thoroughly. The use of colours ground with acidified oils is one of the principal reasons why pictures crack.

We should always be careful, before grinding the colours, to assure ourselves by means of litmus paper that the oil is not sour; which often happens after submitting it to operations said to be for purifying it and rendering it siccative.

THE GRINDING OF COLOURS.

In the process of oil painting, colours are used at different degrees of opacity and transparency; we must therefore give to each of them one of those qualities, in the proportion which suits it best, and it is by an intelligent and sensible grinding that this result can be obtained.

Unfortunately, most of the people who grind colours for artists are merely concerned with the commercial side of this industry. To prepare colours which shall keep fresh in tubes the longest possible time and in all climates, such is their principal object; but this object, good for the foreign market, is not so for us. If, unlike the ancient artists, we do not ourselves grind the colours, we should at least be capable of doing so, in order to know if those to whom we entrust the important care of preparing our colours do it properly.

People are not agreed as to whether ancient artists preferred to paint with linseed oil or poppy oil, and it is now scarcely possible to clear up this mystery: now only poppy oil is used, except for some dark colours, where the use of linseed oil is extolled. We shall not trouble the grinders with this subject, as it is really of little importance;

and since poppy oil is preferred as rendering the colours less viscous, let us have poppy oil!

But what we cannot admit is the exaggerated quantity used—generally one third more than really necessary. Now, as oil is pernicious for painting, because it darkens it and changes fatally with time, no more should be introduced than just sufficient to obtain solidity.

Many artists, convinced of this excess, have adopted the custom of leaving their colours some minutes on blotting paper before using them. It would surely be more practical not to put so much in than to take it out afterwards. But the grinders allege that the colours would then be too dry to grind, that a great many of their customers never find them sufficiently liquid, and at last the eternal bad reason that they have always done so. The truth of the matter is that colours ground liquid keep longer, and then—oil costs less than pigment, and the more there is of the one the less there is of the other. Only the colours are so thickly charged with oil that they would run on the palette if wax were not added to restore some body to them; the more wax the more oil may be put: one might even do without any pigment at all. With a few grains of aniline dye, you may dye more than a pound of a gluten made of wax and oil, and thus have colours superb in tone and of a very consistent thickness.

In fact, we are brought back to the oil and wax method formerly invented by Taubenheim; and the great inconvenience which results from it is that the oil, sinking into the canvas or panel, leaves the wax on the surface, and that the following coating does not adhere to the preceding one because oil does not hold on wax. All artists have noticed that very often, when wishing to scrape away roughnesses, they raise a pellicle, and that by continuing they can take

away a large piece which has not assimilated with the sketch over which it has been repainted.

Besides this great fault, compromising the solidity of the painting, the introduction of wax into the colours reduces their opacity and intensity : not only do they no longer cover the canvas, but they deteriorate, for they derive their richness neither from oil nor wax, but from colouring-matter.

Grinders allege still that wax gives body to the paste, which yields better to the palette knife, and that it gives to the colours a smoothness which all artists now seek.

To this we answer that they can perfectly well grind closer than they now do (it is only a little more fatiguing). By putting less oil the colours remain dull without the need of wax ; and if the paste seems too firm in certain cases, it is easier to add oil than to take it out.

Besides, there is a very simple way of satisfying everybody : it is to grind pigment according to our wishes for those artists who wish to return to sound tradition, and to continue grinding in the modern way for those who paint trowel-fashion, or undertake long voyages.

By grinding colours with only the quantity of oil strictly necessary, we are able to introduce other useful substances to perfect the different qualities that we require from each of them. With more or less resin soluble in oil, cold, we shall increase at will the transparency of some, leaving to others all their opacity ; and if we fear that in this condition the paste will be too stiff to be convenient, we can increase its fluidity by means of a petroleum but slightly volatile, which, taking as long to evaporate as oil does to dry, will give us, whilst working, the feeling of a pigment containing much oil. If certain colours ground in these conditions showed a tendency to run, like vermilion for example, one might add to them, instead of wax, a salt of aluminum with

which the consistency of pomade can be given to oil without any inconvenience. The colours, being thus conveniently prepared, might be used as they are, especially for painting solid work. But it is necessary, in certain cases, to be able to increase fluidity, siccative, and transparency. It is to answer the call of these three indispensable qualities that the innumerable quantity of ingredients has been invented which are mixed with colours on the palette, and which, under the names of unguents, pomades, balms, mediums, lotions, gluten, varnish, essences and siccatives, litter the studios, and are, without exception, poison for painting—in different degrees, however. We are about to try and put a little order into all this collection.

ESSENCES.

If we wish to render a colour liquid, to sketch clearly, glaze or paint transparent and vaporous objects, we use an essence which distempers the colour. Many essences are used for this purpose: essence of lavender or aspic (a variety of lavender), essence of turpentine.

All the essences procured by distillation from plants or resinous balms have the fault of becoming resinous by contact with the air. They get thick and yellow: it is then said that they are greasy. Arrived at a condition of bird-lime, they are no longer volatile, and consequently, not drying, they become a cause of cracks in the painting.

One must be careful to rectify them, *i.e.*, to distil them afresh before using them.

In this rectification, the parts already resinified remain in the alembic, and the essence once more becomes limpid and colourless; but in a short time the phenomenon occurs again, and none but recently rectified essences should be

used, so as to diminish as much as possible this inconvenience; as for suppressing it entirely, that is impossible, if merely from the fact that it evaporates on contact with the air; the purest essence becomes resinified, and there always remains a viscous residue which never dries, but gets yellow and attracts and retains all dust. A true manufacture of black.

In fact, all essences, without exception, cause paintings to blacken, and become yellow.

If they have not hitherto been discarded, it is because there has been nothing to replace them with; but now we find in petroleum liquids offering many more qualities without inconvenience.

PETROLEUMS.

Petroleum, by taking in distillation only volatile particles, evaporates without forming any residue. It serves as a means, and leaves nothing behind it. Spread on white paper it is impossible when evaporated to find even any trace of it.

Further, the facility of having it at various degrees of volatility allows the work to be regulated according to the desire of the artist. We have obtained some essences of petroleum which evaporate in five minutes, others in an hour, others in several hours, and even in several days (see next page). At this point it will be useful to make a little observation. It may seem that very volatile petroleum, evaporating in five minutes for instance, and petroleum but little volatile, only evaporating in several days, mixed in different proportions, would be sufficient to obtain all the degrees of volatility. That is an error. The petroleum which evaporates in five minutes is distilled between 100 and 150 degrees of heat; that which only evaporates in

several days is distilled between 300 and 350 degrees of heat. Now, if you put half of the one and half of the other, say twenty grains in all, into an open vase, at the end of five minutes only ten grains will remain; that which evaporates in that length of time will be gone, but the remaining ten grains will require some days to evaporate.

These essences of petroleum should therefore be carefully kept apart, and not mixed together except in cases where one might reasonably benefit from those differences of volatility. For instance, having to paint a sky rapidly, you wish your colour to be very liquid, to spread it on easily, and afterwards suddenly less liquid, in order to finish. You will take then, as a liquid to mix your colours, a mixture composed of a petroleum evaporating very quickly, which will be gone when you have finished the sketch, and another much slower, which will remain as long as you require to finish it.

Products derived from petroleum submitted to a special treatment, become absolutely colourless, and can be rendered almost inodorous, which gives them a great advantage over all other essences, whose penetrating odours are insupportable even to professional artists. This advantage, and that of leaving no residue, are not the only advantages which petroleum has over essences. It is further superior by its power of penetrating through bodies, and especially through dry oil. A drop of petroleum on a canvas long after painting, goes through the painting without dissolving anything, and comes out at the other side there, where essence of turpentine would not even penetrate. It follows that resins, oil and transparent colours diluted with petroleum are carried by it much farther into the depths of the old coatings over which they are laid, than they could be by any other medium.

To understand the importance of this quality of petroleum, it is necessary to know how one coat of paint operates on another. It is not like gum, where the new coat, distempering the preceding one, unites with it. Here the fresh oil has no action over the dry oil, and the adhesion is entirely mechanical.

The oil of the new coat filters into the old by a multitude of little wells remaining open, which are like the pores of the skin, and these filterings hardening become solid filaments, remaining rooted in the old coat like the roots of a tree in the earth. Now, according to whether the oil-painting be more or less dry, its pores are more or less open; a time arrives when they are sufficiently shut up for no new oil to be able to enter; but petroleum penetrates these perfectly, and if you have been careful to rub an old painting over with it before repainting the upper surface, the new oil dissolving in the petroleum will be carried by it to where it could not have filtered alone.

If the colours contain wax, adhesion does not take place, as has been said above, and it is now easy to understand that in fact this wax, corking up the pores, does not allow the oil to cast its roots; in this case, petroleum, instantly dissolving the wax, uncorks the pores, and adhesion can take place. For all those reasons you will do well to use petroleum. If, however, your fancy inclines to turpentine, only use it when rectified and renew it often, like the boy who remains faithful to his friend but who changes the friend every month.

SICCATIVES.

There is only one means known of rendering oil very siccativè, *i.e.*, to add to it oxides of manganese and lead; not either, but both at the same time, and in equal proportions.

Why so?

We are about to have the boldness to try to explain.

We have said that in order to pass from the liquid state to that of solidity, oil is required to make with oxygen a kind of combination. This oxygen the oil takes from the air, but it can absorb an appreciable quantity of it without combining with it, and consequently without drying.

Oxide of manganese has the property of taking the oxygen where it finds it, and by the help of the oxygen transforming itself into double oxide.

Oxide of lead has the property not of taking oxygen wherever it may be, but from those bodies which had already combined with it.

As for oil, it only combines well with oxygen when at transition point—*i.e.*, when leaving one combination to enter into another.

In fact, we have three thieves who constantly rob each other; let us watch their operations when united.

Oxide of manganese, taking oxygen where it finds it, takes even the oxygen brought by oil when not yet combined with the oil; by this means it gets speedily rich and becomes bi-oxide, which is the millionaire of oxides. Then oxide of lead steals its money, *i.e.*, its oxygen, to appropriate it to itself.

Oil appears afterwards as the third thief, and takes the oxygen to itself at the precise moment when it is passing from the manganese to the lead, for it is in those conditions that the oil combines best with oxygen. Here is an illustration.

A man has in his meadow grass which contains azote, phosphorus, and other matters required for his nourishment, but which, in this form of grass, would be difficult for him to digest. He gives this grass to his cow, which eats it, and

thus absorbs the azote, phosphorus, etc. Then the dairy-maid milks the cow, and the man, drinking the milk, re-finds the azote, phosphorus, etc., which under this new form are to him perfectly digestible, and he may then profit largely.

If this explanation does not enable you fully to understand what happens when oil is brought into contact with a siccative on a basis of manganese and lead, it may at least give you some vague idea of it.

The most common type of this kind of siccative is that called *Courtrai siccative*. Its manufacture is at the same time barbarous and mysterious. If you ask information on the subject from the colourmen, they are as dumb as if their back-shop were the seraglio of the Sultan; or rather they will tell you that they have their siccative direct from Courtrai. Some one was simple enough to go and see. At Courtrai they did not even know what it was! The truth is that the colourmen do not make the siccative themselves, and the majority of them do not know how it is made. They content themselves by insisting that it shall be very black (this is absurd but quite true), so that the manufacturer, who might with care make a better production, is quite at liberty to let all impurities pass, since it is never sufficiently dirty, and he is obliged to add lamp-black to it.

Colourmen receive this siccative in large cans, and they content themselves with putting it into bottles, the smallest possible. Those who are more conscientious than the others (there are some) wait for some time until it clears; before performing this operation; but then there remains at the bottom of the can a large quantity of muddy deposit, and one must be very conscientious to consent to such a loss as that.

This siccative should be made chemically pure; it would

then be much less coloured, and it might be introduced into colours in the form of paste. One would thus have the advantage of being able better to regulate the necessary quantity; for too much is always used, and this should not be with colours that do not dry easily. If, however, you choose to continue the liquid form to which we are accustomed, it should first be made with petroleum instead of turpentine for reasons already stated, and it should not be kept within reach in a cup fixed to the palette, as is generally done, because every instant the paint brush is dipped into it, it is used as essence and in the end a ridiculous quantity is used. This is all the worse, because when used in more than a certain proportion it does not aid drying, and it is destructive to introduce oxides in too large proportion; for, when the oil is saturated with them, they continue their effects to the detriment of certain colours with which they remain mixed.

CHAPTER VII.

RESINS AND VARNISHES.

WE cannot, for this study, follow the method which we have hitherto used ; for, if it be indubitable that ancient artists mixed resins with their oil-colours, it is impossible for us to know, for several reasons, what those resins were.

1. Chemical analysis is still powerless in this respect. Resins not having been seriously studied by any one, their composition is not known ; we know that they contain hydrogen, carbon and oxygen, but the formulas are not settled. The proportionate quantities of those three substances vary, not only in each resin, but they change perpetually by contact with the air, whether in solution or in a dry state ; so much so that in analysing a resin taken from an old picture, we have the proportions of hydrogen, carbon and oxygen at which it has arrived in this musty condition, but it would be impossible to infer from this statement what the proportions in its primitive state were.

2. The researches which can be made in old works treating of painting only furnish very obscure information about the resins formerly used, whilst the names under which they are designated are, for the most part, unknown to-day, and those names which have traversed the centuries have always been applied indiscriminately to all kinds.

The names of resins, even in our time, are not yet fixed ; what is called copal gum in France is called quick resin

in England, and *vice versa*; this copal gum is alternately named gum of Calcutta, of Zanzibar, etc.—not according to the names of the places of its production, but merely those of the countries where stores for it have been established. Now, as the route of ships has been modified through steam, the boring of isthmuses and other circumstances, the places of storage have been changed and the names have been altered. Besides, arbitrary classifications have been made. Thus several kinds of resin have been arranged into three categories: hard copals, semi-hard and soft copals, sometimes also known as male and female copals. Hard copals were the male, and soft copals the female. This classification permits the sale without fraud, under the general name of *copal varnish*, of the commonest and least solid solutions of resins.

To increase yet more the confusion, it happens that the custom-house has imposed a heavy tax on all resins imported, leaving gums scarcely taxed. Immediately commerce hastened to call gum all that had hitherto been called resin; and now there are only coarse resins, refuse from the manufacture of essences manufactured in France, which have preserved their names. The result of all this is that when one finds anywhere a recipe for varnish, one never exactly knows of what resin the author is speaking. It is thus that we find continually processes detailed for dissolving the true hard copal, whether in an essence, in alcohol, or in any other solvent. Now, the true hard copal does not dissolve in anything! absolutely nothing! Or at least if any solvent exist, it is not yet discovered. It therefore follows, that not to treat as deceivers those practitioners who profess to have dissolved it, we must conclude that the resin which they have taken for hard copal was not the same as that which to-day bears this name. We have, therefore,

nothing to gather from the examination of old pictures on this subject, and we are obliged to take the resins in the condition in which modern commerce presents them to us.

We class them into four groups, not basing them either on their names or their places of production—all that may still be changed—but on their solutions, which do not change.

Group 1.—All the resins which dissolve entirely in cold alcohol, and not in essence, like *gum lac*.

Group 2.—All those, which are dissolved in their own essential oil, and can be put over another essence, such as *Canada balm*, balm of *Copaiba*, turpentine of Scio, of Switzerland, of larch, of Bordeaux, American resin (*elemi*), etc.

Group 3.—All those which dissolve equally well in alcohol and cold essences, such as *mastic*, *sandarac*, etc.

Group 4.—All those which do not dissolve in anything without the help of fire, such as *Manilla*, *Madagascar*, and copal gums, etc.

What is to be done in order to find, in all that, the elements of a varnish suitable to be used with colours?

Works of reference are only filled with empirical recipes, eternally copied, twisted, and never actually tried by him who describes them! If some author brings occasionally a novelty of his own, we find fantastic mixtures, as for example to have oil cooked with lime to use as a pomade for touching up.

The scholar who gives this recipe to artists had already given them (he gave many) bitumen and greasy oil of sad memory: one might say leprosy and plague.

He had been speaking of a journey to Italy, and he relates himself how he made this fine discovery. One day, he stopped in the street to contemplate a noble old man who, on the threshold of his door, was painting a picture yet

older than himself. This circumstance was not surprising in a town where every one is more or less of a broker and restorer of pictures ; but one peculiarity had forcibly struck the traveller. This old man was not alone ; he was accompanied by a little pot ! Yes, a little earthenware pot in which was some strange substance. Into this little pot, the old man automatically dipped his paint brush at regular intervals ; and each time that, after this immersion, the paint brush came back to the picture, the picture became darker and older !—Oh ! the secret of the little pot or death, is it not ? (This was in 1830.) This secret the old man had from his grandfather, who had it from his, who had inherited it from a friend one of whose ancestors had formerly bought it from a robber !—who had stolen it from a celebrated monk—in the neighbourhood of Florence.

Fra Bartolommeo !—Hush, old man.—Be quiet.—Here is gold !—And the little benefactor bore the treasure over the hill, without explaining that this mixture of baked oil and lime was only a kind of black soap !

We cannot enter into details of all the recipes which have been published ; they may ultimately be reduced to this :—

1. Use balms in their natural state :
2. Dissolve one or more resins in alcohol and essences, and use them as varnish :
3. Bake resin in oil to make oily varnish ; and add wax to it to make pomade.

The use of balms is to be discouraged, because the essential oil which they contain, requiring a long time to evaporate, prevents the colours from drying regularly. It forms a crust on the surface, whilst inside parts remain soft ; and as essence of balm always evaporates at last, even if it should be through the pores of the dry soil, the lower coatings then shrink, and the surface is liable to crack.

Alcohol varnishes are not used in oil painting ; but there is one of them which is too frequently made use of on account of its being convenient ; viz. :—Soehné retouching varnish. It does not mix with colours, and it is only used to get out an *embu* * and to repaint over the top. This varnish is absolutely pernicious, because it has a basis of gum lac and being altogether insoluble in oil the coatings of colour are thus separated into isolated flakes, making of the picture a mass of leaves without cohesion. Besides, this varnish is easily affected by damp, which makes it dull and bluish. Essence varnishes have all one great drawback : they do not evaporate completely, but leave a viscous and coloured residue besides the resins with which those varnishes are made, are either not soluble in oil, or form with it a mixture disagreeable to use and even decomposing in the presence of siccative, such as mastic for example.

As for oily varnishes, only one is known—oil copal. It is the same as that used in the thirteenth century by a learned monk to preserve the paintings in his convent.

He prepared it himself during the calm of the night, on account of the dangers of the operation ; and when the peasants, returning from the fields passed near the old chapel where he had installed his laboratory, they crossed themselves when they saw the pestilent vapours, all red with reflection from the brazier, escaping from the windows. Since then nothing new has been discovered, except that it is no longer in old chapels, but outside the barriers of towns, that this dangerous and disgusting manufacture is carried on.

It has remained absolutely at the same point. Some makers, not even yet knowing that mercury thermometers

* *Embu* is equivalent to the English word sinking. It means a part of the picture where the painting is dull owing to the foundation having absorbed in the oil.

exist registering to 400 degrees, have no other means of ascertaining the temperature of oil than by frying in it a clove of garlic and a crust of bread.

Let us therefore take this production such as it is and see what we can learn from it in the cause of painting. From all the resins which do not dissolve in oil without the help of fire we shall choose the most beautiful and the hardest, true copal, leaving all the others as only fit for varnishing carriages.

To recognise resins at first sight it is not enough to have read the description of them: one must be in the habit of manipulating them. If young artists had at their disposal specimens of all the resins and also of all materials used in painting, they might, without much trouble, familiarise themselves with all the products of nature or science the very names of which are unknown to them at present: and this would be of great use to them later. It seems that at the School of Fine Arts a collection of this kind ought to have its place in a laboratory, where a practical chemist might show to the pupils the different elementary preparations which constitute art materials! Let us hope! True copal dissolves at 370 degrees of heat. Subjected to this temperature, it sends forth vapours which condense into an empyreumatic oil, as do all resins soluble under the action of fire.

When copal has thus lost in vapour 10 per cent. of its weight it can be dissolved in the essence of aspic: this is what it called copal essence forming the basis of Haarlem siccative (but do not go there to seek it). In this condition, copal neither dissolves in oil, turpentine, nor petroleum, and it yields a bad result if mixed with colours.

It appears to cause them to dry because as soon as the essence of aspic evaporates, not remaining dissolved in the

oil, the copal dries by itself; but it also brings into the painting a foreign matter which does not incorporate with it. (We shall speak of its effects later.) In all cases, those preparations are only false siccatives which in no way dry the oil, since oil only solidifies when mixed with oxygen. When, continuing the operation of dissolving copal by heat, the copal has lost 25 per cent. of its weight, it can be dissolved in oil and essences, even cold. This is the production known as *copal oil*. It can then be painted over essence or petroleum, and it is no longer destructive to the painting except that it is very yellow and becomes even more so with time. It dries badly and leaves a dull surface.

In reality, this resin, dissolved in oil, is no longer hard copal: if we separate it from the oil, it is dry, yellow and friable between the fingers like colophony.

It is, therefore, not worth while to take the rarest and most solid resin, since it can only be utilised by making it like the commonest and most fragile.

Before the experiments which have permitted us to know this were made, copal was put into oil over the fire, and, seeing it melt there, it was imagined that it was thereby incorporated with all its qualities. To-day we are forced to acknowledge that the same disintegration takes place in warm oil. As soon as the oil attains the temperature of 370 degrees, the same vapours escape, and it is only when the copal has lost 25 per cent. of its weight that it begins to dissolve. Only it is almost impossible to prevent the oil from rising to a higher temperature, and then the copal burning becomes partly charcoal, which, with its empyreumatic oil, makes actual tar. It is the same with all the resins of the fourth group requiring the help of fire. They themselves are not dissolved; it is only the product of their dissociation that is dissolved. Amber, succinum, or

yellow amber about which so much has been said lately, acts like copal. Yet persons, whose veracity may not be doubted, have affirmed that they have found the means of dissolving amber or copal without the help of fire. There is only one remark to be made about this; it is that copal may be dissociated by some chemical means other than heat; thereby obtaining the same result.

What we should like to see would be a varnish made with copal, which, once dry, should be as brilliant, as transparent, and as hard as copal itself. That has not yet been seen!

As far as we have arrived, the result is that no resin known is suitable to be used in painting.

Must we, then, wait until others are discovered? No! One must be made, or rather one must be purified. After many trials and much patient study, we can affirm that nearly all resins, as they are collected, are in a partial state of disorganisation; or, if you prefer it, just about to be organised, which is almost the same thing. All their parts are not soluble in the same solvents, are not coloured alike, do not melt at the same degree of temperature, and do not contain the same proportions of hydrogen, carbon, and oxygen.

One single resin we have been able thus to separate into twenty-three different parts. Those parts are in varied proportions not only in each resin, but even in the same resin the proportions are perceptibly variable from month to month. Would they continue to vary indefinitely, or does there exist a definite condition towards which all those parts are travelling and at which they will stop? We do not know. We have never found any arrived at this condition. On the contrary, we have remarked in several a more or less considerable part no further divisible, uncoloured, hard, crystallisable, perfectly transparent, soluble in cold oil and

petroleum; and which would be, were such a definition admissible, the *normal resin*, having as yet undergone no transformation. This is the *normal resin* that you ought to seek, if, you want a substance invariably the same, whatever may be the climate of the country, the nature of the soil where the tree grows which produces it, the manner in which it is gathered, and the changes to which it has been subjected; for all those conditions which one cannot know influence the composition of the resins, which consequently, although of the same kind, are never absolutely alike. With the *normal resin* we shall compose, by the help of petroleum at different degrees of evaporation, the three kinds of varnish which are necessary to facilitate the process of oil-painting:

1. Varnish for re-touching;
2. Varnish for painting (or oil varnish);
3. Picture varnish (or final varnish).

VARNISH FOR RE-TOUCHING.

Dull patches or sinkings, of which we shall speak later with regard to the painting of a picture, should not trouble the artist, since, with a light scumbling of *re-touching varnish* he can remove them whenever they appear.

As this varnish dries in a few minutes, it can be immediately painted over; and as it forms a solid link between the different coats of paint, it is even very necessary never to repaint any piece without first painting it over with this varnish as a preliminary.

It can be mixed with colours to make rapid glazings, but it is too volatile to be used for solid painting.*

For this purpose painting varnish should be used.

* If, however, in certain cases, this quick drying is no inconvenience, there is no other objection to painting with re-touching varnish.

PAINTING VARNISH.

This varnish, which should be kept in the trough of the palette, is used for painting by mixing it, by means of the paint brush, with colours whose fluidity, brilliancy, and solidity it increases. It is of excellent service for glazing, and, not being too siccative, it allows a long time for shading in the fresh paste. It replaces re-touching varnish in all cases where it is desired to paint on wet instead of dry canvas; and mixed with re-touching varnish in all proportions it can be used for all requirements. All these varnishes are composed of purified petroleum, more or less volatile, leaving no residue after their evaporation, and composed of solid matter perfectly soluble in cold oil. So that, whether they are painted over, or directly mixed with the colours, those substances are always penetrated by the oil, dissolve easily in it, and, completely incorporating with it, they give to it much more resistance, without withdrawing from it its suppleness and without hindering its work of narrowing. Further, those varnishes render the drying of the painting quicker and more equal by a phenomenon which a short explanation will make clear. As we have already said, oil must be oxygenised in order to dry. Left to itself, it borrows oxygen from the air. If siccative be added to it, the siccative collects the oxygen and transmits it to the oil, which is a quicker process; but in any case, contact with the air is always indispensable.

When the first film forms on the surface, this contact having no further hold than through the pores of the dry oil, the drying of the deep coatings is naturally kept back until this film thickens. Now, amongst the materials which these varnishes contain, is to be found a rather large quantity of oxygen in a chemical condition which renders it very easily

assimilable with oil: the latter can, therefore, oxygenising without the help of air, dry much quicker, and in an equal degree at all depths.

It is again useful to explain that all re-touching varnishes, and all glutens, pomades or siccatives that have been until now introduced into oil-painting, besides their characteristic of becoming yellow and black, have the serious fault of being largely composed of substances insoluble in cold oil, so that the successive coats of paint are separated by isolating pieces, and the oil with which these colours are ground is divided by foreign substances, unequally distributed, which solidify quicker than the oil and become harder and more brittle.

It follows that the oil, which contracts whilst drying, can no longer do its work regularly, in the midst of all these obstacles; it then happens that successive solutions cause the outlines of cracks that go on, always increasing as the work of the oil proceeds. And this process of oil-shrinking continues for years!

These accidents are not prevented by the final varnish, as their causes lie below. Often the accidents are rendered worse by the final varnish, for it brings a new resistance, if it is not perfectly supple, and it cracks in its turn when too dry. The greatest care should therefore be exercised in the choice of picture varnish.

PICTURE VARNISH.

The final varnish which is painted over the finished picture has for its object, whilst giving brilliancy and transparency to the colours, to preserve the picture from direct contact with the impurities liable to be deposited on its surface, as well as from the gases in the atmosphere; and

that, without trammelling the incessant work of shrinking and dilatation of the oil, the wood and the canvas.

In order, therefore, that this object may be attained, the varnish must remain uncoloured and transparent, at once resisting and supple; it must be possible to wash it when dirty, and should it be desirable to take it off, it must be possible to do so without spoiling the picture.

Now, all varnishes hitherto employed become more or less yellow as they get old. They get blue with dampness, sticky with heat, crack, and in time always finish by getting white and opaque. They cannot be washed when dirty without spoiling them, as they do not withstand damp. They have to be renewed, and can only be removed by rubbing them with the finger, or by damping them with alcohol and essence of turpentine. All those processes, however careful one may be, always attack the painting a little,—so much so that after several removals of varnish the picture is half destroyed. Many amateurs know this danger, and they often prefer to keep their smoky pictures, almost invisible under deteriorated varnishes, rather than risk experiments.

The varnish which we propose joins to all the requisite qualities the great advantage of being easily cleaned as often as may be desired, without changing in any way, which enables the pictures to be kept in a constant state of cleanliness, absolutely necessary for their good preservation. The petroleum with which this varnish is made, evaporating less rapidly than the essence, renders the varnishing much easier, by enabling the operator to apply the coating more leisurely, without the drying being thereby retarded: quite otherwise, for this varnish is completely dry at the end of about an hour. Further, as it does not contain any viscous matter, there is no stickiness to attract the dust in the air.

For directions for varnishing see APPENDIX—"Varnishing."

CHAPTER VIII.

CANVAS, PANELS, AND THEIR PASTES.—SIZINGS.

HAVING chosen with the greatest care the materials required for painting, we have still to know on what we are going to paint; the question of canvas, panels, etc., is one of great importance.

A picture is composed of three altogether distinct elements :—

- 1 The support, or the material substance painted on, as wood, canvas, stone, paper, etc.
2. The coating or sizing used to cover the material support.
3. The final painting, formed by successive layers of colour applied over the sizing.

If the painting be done under bad conditions, and contain in itself the germs of its destruction (spoken of above), the picture is irretrievably lost, and that in spite of the good quality of the support, and of the sizing.

But, admitting the hypothesis that the painting is as perfect as it ought to be, it is also necessary that the two other constituent parts of the picture (*i.e.* the support and the sizing) should be perfect.

The support will first be chosen as substantial as possible, but it can still be preserved from many causes of destruction by covering it behind and on the sides by means of mastic and suitable protective varnish. (*See APPENDIX—"Panels of Unpolished Wood."*)

If, however, it happens to spoil even when all precaution has been used, a clever picture restorer can still save the painting by transferring it to another canvas or panel, always provided that the sizing sustaining it remains in good condition.

A proof of this preservation of painting on destroyed supports is to be found in an examination of the old triquetrous altar screens, whose three panels of the same wood, painted by the same artist over similar sizings, are in the best conditions to be usefully compared. Nearly always the middle panel, remaining attached to the wall, is rotten, owing to damp, while the two side leaves, being surrounded by air, are yet perfectly sound. In those conditions, when the sizings are good, the painting is equally preserved on the middle panel and on the side leaves, whilst on the contrary on bad sizings, the painting is spoilt on the rotten panel and preserved on the leaves in good condition.

In fact, therefore, the preservation of the painting depends on the quality of the sizing. It is not enough that the sizing should be solid: were it like steel, indestructible as the diamond, we should still require to have it less brittle; for should it scale off, melt or powder, it would involve the painting with it. It must even be sufficiently supple to lend itself to the peculiarities of the painting, as it contracts when drying, and yet it must be of sufficient resistance to preserve the painting from too sudden movements of the support. It should absorb the excess of oil and varnish which comes to it from the painting, and it should reject all which might penetrate through the support. In short, compelled to obey the slightest caprices of the one and to resist all the attacks of the other, it is required from it, as from all servants, to be equal to the occasion.

Notwithstanding the importance of the *rôle* which the

sizing plays, and perhaps rather on account of this importance, it is often suppressed—first, for painting on paper in water-colours and pastel where it is not necessary, and sometimes even for oil painting when done directly on the support.

In this case supports should be chosen having something of the qualities the sizing would have had—*i.e.*, dilating little and shrinking little, of a fine texture, uniformly porous, and containing neither acids, resin, nor any other matter capable of influencing the colour; if found too absorbent it will be well before painting to brush the support over with a little re-touching varnish, or painting varnish, or a mixture of both, according to whether the painting is to be in a dry style, or the colour is to glide smoothly over the surface. (See Chapter IX.—“Oil Sketching.”)

The ancients painted on wood, on tanned skins, on lava, on marble, on slate, on metals, on walls covered with lime mortar, and on stone itself, after having saturated it with a sizing of resin made to penetrate by the heat of a chafing-dish.

Their portable panels were very thick and very solid. It is related that at the siege of Rhodes the soldiers made use of pictures by Apelles for a table. In the middle ages the same substances were used to paint on, but especially wood, chiefly oak and poplar.

The joins of the boards which formed the panel, and its coating, were made of animal glue (*Taurocoll*), or of flour-paste mixed with plaster or chalk, or even with a paste made of cheese and lime, the recipe for which Theophilus gives in a celebrated manuscript. This last paste is by far the most solid. It has been proved that on old panels altogether rotten the coating remained intact; and that even at the place where the joins were solidified by bands of canvas

prepared with this paste, the wood which it covered had been preserved.

Sometimes, for valuable pictures, they gummed all over the surface of the panel a leather coated with resin or covered over with plates of gold. But as they could not make those plates as thin as they are now made, they were valuable enough to tempt the cupidity of the iconoclasts, and nearly all the pictures painted on those foundations considered indestructible were just the ones that were first destroyed.

The exclusive use of wood panels was preserved in Italy till the time of Raphaël, and in the Low Countries much later, till the time of Rubens.

At that time so strong was the conviction that panels for painting should be scrupulously chosen, that government had monopolised their manufacture.

Only perfectly dry and faultless wood was used, the workmanship was of the best, and it was forbidden, under penalty of fine, to paint on other panels than those of the government, for the following reasons: "that the genius of an artist is the patrimony of his country; that it is the duty of the country to guarantee the longest possible duration to its masterpieces, and that, to make this sure, equal precautions should be taken with regard to all pictures; as a painter, however celebrated he may become, always begins by being unknown, he may by chance be modest, and consequently ignorant of the ultimate value of the work which he undertakes, and therefore the possibility of his compromising the work by negligence or economy should not be permitted."

This law, which to-day would make many people smile, was rigorously enforced during the zenith of the Dutch school, and it is perhaps to it that we owe the preservation of many of the finest gems in European museums.

When canvas became more general, the sizings which had been used for wood panels were continued; and it is on the same concoctions of paste and chalk that the first canvas pictures were painted. These concoctions were afterwards abandoned by degrees—*i.e.*, the sizings of paste, getting thinner and thinner, were re-covered by others made of oil and white lead, and finally no paste was used at all. But it was soon observed that canvas, in direct contact with oil, burned and became like touchwood. This sad fact established, artists returned to the use of a first coating of paste, merely to separate the canvas from the oil coating; but this first coating was of a gelatinous substance susceptible to damp, and the canvas became rotten.

Another method was then tried—*viz.*, putting behind the canvas another coating of separating paste re-covered with a second coating of oil and passing them between two cylinders to press them. But, thus imprisoned, the canvas lost all suppleness, and could no longer be stretched on the frames; then they stretched the canvas first, and the coatings put on the stretched canvas were merely numerous coatings of oil-white, and by therewith entirely covering the grain of the texture, manufacturers tried to get a surface as smooth as that of a panel.

This method had the inconvenience of encumbering the studios with frames, each canvas requiring two or three years of constant exposure to the air for its preparation; trying to shorten this time, siccative means were used—such as replacing a portion of the oil with essence of turpentine, using oil prepared with litharge, umber, or red earth mixed with white and sometimes even using no oil at all.

These practices were not calculated to improve the qualities of a coating already doomed to scale off fatally—quite the contrary; but they facilitated the manufacture of a

kind of canvas which assured to artists a rapid and valuable execution in great favour for a long time especially amongst portrait painters whose supreme ambition was to imitate porcelain.

Did they suspect that they would imitate even its cracks? In any case, time has amply revenged the flimsiness of those guilty pretensions: to-day a portrait of an ancestor that is *cracked* loses much of its value!

After this period of brittle canvas, the ordinary laws of reaction brought on a taste for supple canvas, and much ingenuity was exercised in procuring this quality. A sizing was added of mucilage paste, such as linseed, snail-slime, honey, fig-juice, etc. An oil was also used, rendered viscous by rancidity—*i.e.*, acidified and never drying. For reasons of economy, manufacturers substituted for white lead, chalk, whites of Troyes, whiting, white of Meudon, white of Bougival, pipeclay, etc., which gave them results just as good in the matter of suppleness, none of the carbonates of lime ever drying thoroughly when they are ground with oil.

Every one knows that glazier's putty, which is made of oil and whiting, will remain soft for many years under a hard and wrinkled coating.

It is easy to understand, therefore, that painting must crack when done over coatings that continue to shrink long after the painting is dry. The invention of railroads, which has changed so many things, is also not without influence on painting canvas, for like all other things pictures also now travel, and the constant rolling and unrolling necessitates the use of more and more supple canvas, until suppleness is now the chief property considered in its manufacture.

This is the present state of the manufacture.

By an inexplicable anomaly, unbleached canvas costs more at the French custom-house than prepared canvas does. Now, painting-canvas being made chiefly in Holland, and hand labour costing less there than at Paris, it has become the custom to apply the coating at the place of manufacture and to send the canvas ready prepared in large rolls: this has the double advantage of costing less and of not encumbering the shops. Further, the canvas being rolled as quickly as possible, the oil deprived of the light before becoming dry, gets rancid and diminishes the suppleness of the coating, as has been said above.

This canvas is therefore perfect? For the tradesmen, yes! But it is yellow, it has a disagreeable odour, and pictures painted on it remain to posterity blackened and cracked. Of course manufacturers do not work for posterity.

By comparing the works which remain to us and by examining the materials on which they are painted, it is easy to convince ourselves that the best preserved pictures have been painted on paste sizings.

Is that to say that all those which are on paste sizings are well preserved? Assuredly, no. But that does not affect the principle, because, very often, the cause of destruction is independent of the sizing, and sometimes the paste used was of bad quality.

Paste should be incorruptible, supple, perfectly neutral, and not susceptible to damp. In this condition it isolates the colours from all chemical reaction liable to result from the support; neither contracting nor expanding, it occasions no cracks, and its suppleness enables it to follow the movements of wood and canvas; whilst oil sizings, on the contrary, oxidise, get yellow, produce chemical reaction on certain colours, shrink, and in the end invariably become brittle.

The conclusion of all this is, therefore, that oil sizings should be rejected and paste used. But it must be carefully chosen.

PASTES.

How should we proceed to study pastes?

As in all other studies, by consulting books treating of the subject.

Yes! but clever practitioners, well informed, have not left books, and one gets mystified with a deluge of manuals and collections scarcely intelligible. The recipes therein found are often impracticable. They are frequently distorted by successive errors of print, and in that condition they are carefully collected, reprinted and perhaps translated into several languages by one of the sham philosophers who write about everything, satisfied with re-copying what has been done before their day, without understanding it and without ever making personal experiments themselves.

It is thus that the greatest errors and follies have come to us through all ages, from book to book, as if they were gospel truths.

If, however, you still desire to consult all those old authorities, here is a kind of key to facilitate their study.

When you hear of oyster shells, crabs' eyes, stags' horns, mother-of-pearl, pearls, you will know that by them is meant carbonate of lime, of which the type is chalk. When you hear of the blood of a pig or of any other victim, of milk, of fresh cheese, of crust of Gruyère, of yolk of egg and of powdered insects, the principle of all that is caseine, fibrine or vitelline, which are almost the same thing.

White of egg is albumen; if you hear of fishes' bladders, cows' tails, old gloves, boot-tags, skins of rabbits, still-born kids, or sheep's feet, all that is gelatine.

All the farinaceous feculents, wheat, barley, sago, tapioca, rice, potato, etc., furnish starch and gluten. Many trees and exotic plants having Latin names, not the same in all books, yield gums and resins; and if in some recipes you read that a candle should be burned over the boiler, it is only the wax which falls from it that can be useful.

As for quicklime, the urine of camels and dung, they act like alkali, and can be replaced in almost all cases by volatile alkali (ammonia).

You will also hear of other unimportant ingredients, which must not be considered as of consequence. Amongst them are figtree sap, syrup of snails, linseed, honey, all used as mucilage to give suppleness, and not one of which is equal to glycerine for this purpose.

All the pastes imagined and described up till now (there are some thousands of them) are really made with only eight substances, four of which are animal and four vegetable.

<i>Animal.</i>	<i>Vegetable.</i>
Gelatine	Starch
Albumen	Gluten
Caseine (or fibrine, or vitelline)	Gums
Wax	Resins

Glycerine as mucilage, and ammonia as alkali, yield an assistance often indispensable.

By taking, therefore, those substances chemically pure, it is possible by mixing them to reproduce all the most complicated ancient pastes. For this purpose it is enough to consider those of the substances which contain the materials composing the paste that we wish to reproduce. For instance, here, in an old manuscript, is the simple recipe of a paste used by the Benedictines to prepare the parchment of missals on which they painted miniatures: "Gather bees during the summer months after vespers; pound them

in a mortar with lime-water, and afterwards filter the mixture through linen."

By analysing this strange mixture, we find that bees contain, like all other animals, a little gelatine and fibrine, and bees further contain wax and honey.

The presence of lime transformed the fibrine into paste, and rendered the wax miscible with water; filtering separated the useless particles, the legs, wings and other impurities. As for the advice to choose the summer months and the evening hours, it is doubtless at that time of the year that bees make most wax and honey, and in the evening that they have most of it.

Let us now consider the subject synthetically. Instead of fibrine we shall take laseine, which is analogous; instead of honey, glycerine; instead of lime, ammonia; we shall add gelatine, wax and water, and, without even requiring to filter it, we shall have made the Benedictine paste, excellent for the purpose for which they used it. It is not at all susceptible to damp, incorruptible, supple, and perfectly good to preserve the leaves of a book destined to be often handled.

And that is how science, which sometimes immolates so many victims, can to-day save the bees from the terrible pestle and mortar of the monks, and leave them to buzz in peace amid the flowers of the meadows!

With the eight substances mentioned, we are not limited to re-making ancient pastes: we can compose new ones.

Only, when we consider that each of these substances can be separately treated in different ways, and that certain of them, such as gum and resin, offer different and numerous types whose qualities should be separately studied, when we consider the number of combinations that can be produced with eight figures, that in each of these combinations the

proportion may be changed many times, and that it is afterwards necessary to try all these pastes, first on supports of all sorts, to see how they are affected by wood, canvas, cardboard, paper, etc. : and that afterwards paintings in all styles should be subjected to dampness, dryness, sunshine, darkness, and that it is prudent to wait several years to judge fairly the results of these trials, it can be understood that it is only toward the end of his career that an honest experimenter can allow himself to say that he thinks he has finished.

Let us now see how each of these eight substances can be transformed into paste or can be assimilated with it.

Gelatine, dissolved in water, gives the paste generally known as animal gluten and glue. Strength may be given to those gelatinous pastes by the addition of quicklime, oily varnish, or gum lac ; or they can be preserved liquid whilst cold by acetic acid or other means ; glycerine, chloride of calcium and indiarubber will give suppleness ; and they can ultimately be rendered insoluble by chromic acid, acetate of aluminum, and bichromate of potash. (See APPENDIX—"Gelatine.")

Albumen is obtained by beating up the whites of eggs in spow, and at the end of an hour collecting the liquid which flows from it. It may also be bought in a dry state.

This paste can also be made supple with glycerine, and becomes insoluble when it is heated to 100 degrees in a damp state.

Caseine may be bought in a dry state from chemical dealers, or it may be extracted from cheese. It becomes supple with glycerine. (See APPENDIX—"Caseine or Cheese Paste.")

Wax is a natural production. It should be chosen free from the suet with which dealers mix it. It is rendered miscible with water by volatile alkali (ammonia). (See APPENDIX—"To render Wax miscible with Water and Glycerine.")

• *Starch* and *Gluten* furnish paste, dextrine, etc. (See APPENDIX—"Starch or Farinaceous Paste.")

Gum dissolves simply in water.—By adding boric acid to gum water it will keep a long time without corrupting. It becomes supple with glycerine.

Resins dissolved in oil (oil varnish) or in essences mix with paste in the state of emulsions, or directly by means of alkali—as gum lac, for instance, which, dissolved in borax or ammonia, can be thus introduced into sizings. (See APPENDIX—"Gum Lac.")

With the above any one can make for himself combinations suitable for all purposes; but we are here limited to the search of better sizings for surfaces destined for oil paintings.

The great fault of those who make researches on a subject and write about it is that they wish to make their readers feel all the extent of their work, and they begin, before giving the result at which they have arrived, by relating all the unsuccessful attempts that they have made—like conjurors who fail in their tricks several times to excite the public all the more when they succeed.

Dismissing this pretentious practice, we shall say at once that the best of all sizings that can be used to prepare canvas, panels or cardboard destined to receive oil painting, is cheese paste (or caseine paste); but there is a way of making it which should be followed to the letter, if good results are wished. (See APPENDIX—"Sizing of Caseine or Cheese.")

When the sizing has been executed on the canvas in good condition, the next thing to think of is the wrong side of the canvas, which also requires a sizing impervious to water and oil, so that the excess of oil coming from the colours shall not go through the tissue, as that might burn it, and so that dampness shall not be able to penetrate it, as that might cause it to rot.

This sizing must also be supple, so that the canvas may roll up easily. Many substances may fulfil those requirements—indiarubber dissolved in petroleum, wax and resin, gum lac. But what is yet better, especially for canvas of small dimensions, undesirable to thicken too much, is to put two coatings of water-colour fixative.

It has been advised through excessive precaution to put also a fireproof coating of some kind as a preservative against fire; but this cannot be put on the front of the picture and would be consequently of little use in case of fire. A better plan would be to nail a metallic canvas on a light frame, attached by hinges behind the picture (so as to be easily opened at will). This metallic canvas, being thus held about half an inch off from the painting canvas, would allow the air to circulate and would preserve the picture from shocks, such as contact with flame, of which there is much more danger from behind than in front; for it is noticeable that in museums, at picture dealers' and in the houses of amateurs, servants who have the greatest respect for pictures when hung pay no attention to them when standing with their faces to the wall: they drag ladders about, and move round with lighted candles through piles of heaped up frames, without taking the smallest precaution, although, on the contrary, they ought to take the greatest care.

We might still, besides the sizings properly so called, whose liquid basis is water, find in the substances which chemistry has already discovered, and will discover, the elements of a sizing more perfect than cheese paste; but we are unable to find one that offers the substantial guarantee which this does of having been used for centuries, and of having resisted all causes of destruction.

If, however, you have enough of confidence in the science of an old practitioner who has consecrated his life

to the study of painting, and if you wish to try something new, here is a sizing which he proposes, and which he considers absolutely perfect:—

Grind zinc-white with alcohol and mix it with water-colour fixative.

Lay on one coating; and when it is dry, which will be in a few minutes, rub with glass paper. As a matter of course, the more zinc-white you add, the more absorbent the sizing will be, but it will be less solid in proportion. (*See APPENDIX—“Instantaneous Sizing.”*)

Over all these sizings we can paint equally well in oil or water colours. Only one question regarding the sizing remains to be considered: and that is, what tone we should prefer to give it. We do not hesitate to answer that the sizing should be perfectly white, and that for several reasons. First, to obtain effects of transparency without the necessity of painting in oil-whites and afterwards glazing, which involves waiting a long time until the under coatings are dry, and sends us back into all the inconveniences of oil sizing. Secondly, because the under coatings always work up a little, and a picture, painted over a coating of any tone whatever, will ultimately always become itself of that tone, especially in those parts least covered. Certain pictures of Poussin and of the French school of the eighteenth century, painted over red coatings, are striking examples of this. Some artists have preferred umber, and even pure black, but their works have not lasted a century. Their pictures have become quite invisible, in half tints, at the end of a very short time.

Apart from the preservation of the picture, there is another important consideration—viz., white foundations naturally cause greater luminosity and that is a valuable quality; darkness always comes on soon enough.

CHAPTER IX.

OUTLINE AND EXECUTION OF A PICTURE IN OILS SINKINGS.

WE have substantial colours, well ground; petroleum volatile in different degrees, siccative, liquid or in paste; re-touching varnish, painting varnish and canvas or panels covered with excellent size, in short, for painting under favourable circumstances, we have everything in good condition.

We shall not trouble about the tools, brushes, paint brushes, knives, pans, etc.; each artist can make his own choice; they do not affect the solidity of the painting. We shall only mention the palette. We advise it to be white, and quite impervious to oil, because that allows a correct judgment of the transparency of the colours, and also tends to keep things light, and the sizing of the canvas or panels being also white, tones will have the same effect on it as on the palette. The latter being impenetrable, preserves to the colours exactly the quantity of oil or varnish judged well to add to them, and a white palette is easy to clean. The utmost cleanliness in palette and all other requisites is quite indispensable.

THE OUTLINE.

Whether we paint on a panel, or on canvas sized with cheese paste, or on a panel of unpolished wood, or on water-colour paper, the outline may be done either in oil

or water colours. If in water colours, it is best to use ordinary water colours, not paste—being careful, if on unpolished wood, not to put on too much wash, so as to have no misadventure with the wood.

1. If the sketch is to be done in water colours on canvas, or panel sized with caseine paste, one very even coat of painting varnish should be laid over it: this varnish will partly soak in with the sizing, and, even before it is dry, the oil painting may be continued. This is the process of Paul Veronese.

2. If the sketch is to be done in water colours on water-colour paper, one very even coating of water-colour fixative should be laid over the paper: this fixative will soak completely into the paper, and will be dry in a few minutes. It is possible that this coating may not be sufficient, because some papers absorb more and some less fixative. The fact may be ascertained by putting a drop of oil on one of the corners: if this oil does not penetrate into the paper, there is enough of fixative; if not enough, then put on a second coating.

In any case those operations cannot take more than from fifteen to thirty minutes, after which the oil painting may be immediately continued. This method allows us to do in water colours the part that they are capable of doing well—viz., the sky, water, etc.—in fact, all the transparencies. The solid parts which require much shading may be done in oils.

The whole once varnished is of perfect solidity and of great beauty of execution.

For this process, paper of fine grain should be chosen, coarse grains always having a bad effect when varnished.

3. When the outline is done in water colours on unpolished wood, it is well to give one good even coating of

water-colour fixative, and the oil painting can be continued as soon as the fixative is dry, which will be in a few minutes.

OUTLINES IN OIL.

If required to outline directly in oil :

1. On canvas or panel sized with caseine paste, paint over the sizing one very even coat of painting varnish which will partly soak in, without which this sizing would be too absorbent. If, however, it is desired to make use of this quality, a rather large quantity of painting varnish should be mixed with the colours to make the work less tedious.

2. On water-colour paper, before beginning the oil painting, one or two coats of water-colour fixing should be applied, according to whether it is desired to have the paper absorbent or not.

3. On a panel of unpolished wood, the outline may be done directly in oil. It is also well to apply first a coating of water-colour fixative, or of re-touching varnish, according to taste, and according to whether the panel is to be absorbent or not. Oil painting adheres admirably to the fixative. When we said that for outlining in water colours impastation was not to be used, it was by way of caution, for it is not a suitable process for this. But if the outlining be done directly in oils, we must also dispense with it, and that requires much care.

Oil colours for sketching should be used fresh ground, being careful to put everywhere the same thickness (a light semi-liquid); so that all the parts, however different in tone, may have a generally equal coating, without blisters or harsh touches.

The merest trace of siccative should be put into black, and the lakes, so that the oil of this first coat, not

drying too quickly, may penetrate deeply into the pores of the object; and the badger brush is not to be used, so that this oil may not be brought back to the surface.

Each part of the picture should be outlined in flat tints, of the lightest and most intense tone possible, of the principal colour of the object which they represent, because the lower layers of colour having always a tendency to work upward, it is best that they should be very brilliant, as this counteracts the tendency to darkness of the uppermost layers.

Great care must be taken to blend the outline, and to leave no careless stroke of the brush to be a trouble afterwards.

Before re-painting this sketch, any roughness which may exist must be taken off with a very sharp scraper.

In short, this outline directly in oil is more a preparation given to a support to make it suitable for painting, than an intelligent sketch. It may be answered: But this is dull and monotonous; it is a manœuvring method; nothing is left to inspiration or to chance. Firstly, let us always, leave as little as possible to chance; and as for inspiration, it is just in order to give it more liberty at the moment of finishing, that we take so much pains with the preparatory part. If, in the warmth of execution, you leave little empty spaces between your touches, you will find them very convenient: the tone of the outline being almost definite no longer needs to be blocked up everywhere; whilst if you introduce another tone into the sketch, all these little intervals have to be filled up, which will soften the execution and give more liberty to the painter. If just at the spot of a delicate detail you fall upon an impastement or an empty place, as will be found in an inspired sketch, you will be greatly troubled, and it will be quite another bungling work to fill up the holes and scratch off the lumps; and frankly, if there is to

be any bungling, it is better it should be below than above. Besides, if the sketch has any faulty features, or any particularly strong points, as in finishing the primary drawing is not exactly preserved, these features are much less troublesome if the outlines and accents are but lightly marked.

Inspiration (here it is!) might induce you, whilst executing the painting, to be satisfied at certain places with a simple scumbling, which would be all right on a solidly and evenly covered foundation; but if you happened just at that place to be on a part of the inspired sketch where there was already almost nothing, those two almost nothings one over the other would not suffice, and you would be forced to fill up with colour this forgotten place, to the detriment of that lightness of execution which is just what you wanted to keep.

Besides, you can always in finishing make the tone as soft, as broken as you wish, on a brilliant sketch, even a little crude, whilst you will never obtain a colour at its maximum of intensity on a dull sketch. On the contrary, by putting an intense colour over itself, you increase its power in a considerable proportion.

In short, it is to leave to the artist liberty to execute to his own taste solid painting, semi-liquid, scumbling, and even glazing, that we advise to him a sketch which never constrains, and which ensures to him the physical possibility, by realising all his fancies, of working out his inspiration as far as he has any.

And then this sensible and regular sketch is the guaranteed health of the painting; it is its under garment.

That we may wear with impunity, at all seasons, light fanciful clothing, we wear underneath a good flannel: well! the sketch which we are recommending is the flannel of the picture.

The sketch being finished must of course be left to dry before re-painting.

As its colours are not thick, and as the oil is partly absorbed in the wood, or in the sizing, it is not necessary to wait as long as if you had sketched on a non-absorbing surface with impastements. A month in a very dry studio, or a fortnight in fine summer sunshine, is quite enough.

When the sketch is very dry, a general coat of retouching varnish should be painted over the whole picture before continuing. This varnish, as we said above, dries in a few minutes, and may be immediately painted over. The object of this varnish penetrating into the sketch is to go and fill up all the empty spaces in the coating of colour left by the oil absorbed into the support painted. Filling up the spaces in the coating of colour, it will deposit on its surface a skin of normal resin, which will serve as a link between this coating and the following one, and it also removes dull spots, and gives more brilliancy and transparency.

THE EXECUTION.

We have said that, in the execution, the artist, released from all trammels, might paint to please his own fancy; we shall, however, remark that excessive impastements, besides not being always seen underneath, are rather destructive to the solidity of the painting, and it is not necessary to make much use of them, since finding always in places which are in the light a luminous sketch, and in dark places a sketch already dark, in order to cover them we shall not require efforts which always show by a thickening of colour, when we want to produce light on a dark ground, or darkness on a light ground.

• Here an objection naturally presents itself, if, in spite

of one's knowledge, one makes a mistake in the sketch, or if one changes his mind—for instance, where he had sketched somebody in blue wishes him to be in red, or if, after having intended to put a coloured tablecloth on a table, it is wished to replace it by a white tablecloth, etc.

To this we reply that there should be no hesitation in promptly and completely removing the sketch with benzine at the place where the change is desired, and then putting in a new sketch as wished.

Of course it is always better, when possible, to put everything in at once without any changing, but it is certain that it is not always possible to do this successfully. Certain portions are sometimes unsuccessful, and glazings are necessary.

When forced to go over a certain piece several times, it should never be done without first rubbing a little re-touching varnish over it, and the same piece should never be re-painted two consecutive times with solid colour: *i.e.*, avoid re-painting.

RE-PAINTING.

If a piece does not satisfy you completely—let us suppose it is a head, whose shading you wish to soften, to colour, or to brighten—with semi-liquids and glazing you can obtain what you desire without being obliged to re-paint. But if, on the contrary, the drawing of it was defective, features have to be altered, the brow made higher, the mouth lower, etc., that would necessitate new impastements in light colours on the dark parts and in dark colours on the light parts. This is what is called re-painting. Sooner or later the re-covered parts will show again, and will be a cause of regret.

Here is a striking example of this kind of accident: There

exist, at the museum of Madrid an equestrian portrait of Philip IV., by Velasquez, in which the horse has eight legs, not all equally apparent, but still they are discernible. It is evident that four of these legs were not intended by Velasquez. Not liking them as they were at first, he had re-covered them with an earth-coloured tone, without removing them from the canvas, and then he painted new ones in other places. It is absolutely certain that when Velasquez finished that picture, the effaced legs did not appear, as he assuredly would not have left them there; and it is not less certain that in time they reappeared.

Re-painted pictures have still another inconvenience, which is, that new colours thickly laid on other thicknesses imperfectly dry at the bottom cause cracks. Here, again, there should be no hesitation in scraping down to the outline the parts to be re-painted in full paste.

GLAZING.

As for glazing, it should never be put on dry if it is desired to have it even.

The following are precautions which it will be well to take. If the place on which you wish to put a glazing has been already covered with re-touching varnish, rub it over with some petroleum oil and wait a few minutes until the varnish gets thoroughly distempered; then put on the glazing, mixing with the colour a little painting varnish, and a little siccatif if the colour be a lake. When the place to be glazed has not yet been covered with varnish, rub a little painting varnish over it and apply the glazing as above.

Besides these preparations one may sometimes be, in certain cases, desirous of rendering the colour used for glazing more or less liquid, sometimes requiring it to be merely of the consistency of a wash. For this purpose use

essence or petroleum oil, according to whether you wish it to dry quickly or not. There is only one observation to be made—viz., that the more petroleum you put in the glazing the more necessary it is to see that the foundation is thoroughly dry. It is a question of taste whether the colour used for the work shall be more or less liquid or ropy. Each artist, with his two varnishes that he may mix in any proportions he pleases and his petroleum more or less volatile, may act as he thinks best : nothing is forbidden, there is no destructive excess to be feared.

The siccative which solidifies oil, on the contrary, should be sparingly used, whether in paste or liquid. Very little should be put into light tones, none into white lead ; and it should be well mixed into the colour with a knife on the palette, so as to be equally distributed.

EMBUS, OR SINKINGS.

Where, in the execution of a picture on account of repeated re-touching, embus or sinkings appear, it is possible, as said above, to make them disappear with a light scumbling of re-touching varnish. This operation should even be repeated as often as the stains appear ; for when an embu is obstinate, it means that the interior vacuums are not filled up, and for the preservation of the picture it is requisite that they should be filled up.

Those embus are the disease of oil painting, and, in order to cure it, it must first be well known. Until now artists have been content with getting rid of its immediate effects, but without studying their causes, and consequently without bringing any remedy to the effects which this malady may have in the future. We are therefore obliged at this point to give some explanations.

Ground colours contain the oil necessary for keeping

together the small parcels of colouring-matter, and for giving to them, according to the laws of refraction in centres of different density, an aspect more coloured and more transparent than if these parcels of matter were in a state of free powder; but that on one condition—viz., that the oil shall remain equally distributed amongst all these parcels. And that does not always occur.

Let us say firstly that, in the case which we are considering, oil does not follow the laws of weight, but it obeys the capillary law, which is that in channels of small dimensions liquids disperse in all directions, as much from bottom to top as laterally or from top to bottom.

Now, the interstices which the imperceptible parcels of colour leave between themselves, form a number of little canals very propitious for this phenomenon. One of the best proofs of this is that the oil does not descend to the bottom of the picture, although the latter is nearly always vertical: it remains in suspension in the layer of colours which contains it, but, in the thickness of that layer, it is differently distributed according to circumstances. That is what we are going to study.

When a first layer of paint is applied to a panel, a canvas or any support—in fact, on the plane surface of any material whatever, if that material is porous, such as wood, cardboard, a wall of stone or plaster—the oil gets partly absorbed into it and the colour remains more or less dull, according to the quantity of oil it has lost. If the materials on which the painting is done have been prepared by means of sizing, still the sizing will always be a little absorbent; and this is requisite, so that the oil by penetrating a little may throw out the roots which enable it to adhere. In this case a little oil is used in this manner, and the colour is still slightly dull, but less so than if there were no sizing.

It would seem that, by continuing to put on one layer after another, the oil from each would filter into the preceding one to fill up the vacuums there formed, so that we should have a succession of layers all dull; yet this does not always occur, for the following reason:—

If you tread on sand which has been wet, water will spring up without the soil sinking. If you even make a little hillock of this wet sand and renew the experiment, water again comes to the top. A similar phenomenon may be noticed in the clay used by potters and in a damp wall when knocked. The more you triturate the colour, the more the oil comes up and collects on the top. Under these conditions a layer of colour applied over another, even if the under layer be sunken, remains bright.

It would still seem that in re-painting over this bright surface the layer should be normal. That does not matter, because the oil, in rising to the surface, has left, in the inside of the layer, some colour deprived of oil: all the little canals spoken of above, produced by the interstices between the parcels of colours, are empty under this exterior sheet of oil, and this is what happens when it is painted upon. The oil, leaving the new colour, penetrates through the pores of the dried oil on the surface of the preceding layer. It is sucked up by the empty canals as if by a sponge, and the result is still an embu. Now, the embu will come whether you re-paint a dull or a bright surface, if that surface, although dry, has not been long dry. But if the bright surface is tolerably dry, and its pores are sufficiently shut to prevent the new oil from penetrating, the painting will be normal; only the canals at the bottom will remain empty, and as often as there are vacuums in the construction of the painting it will be to the detriment of its durability.

It is like a wall made of dry stones merely covered outside

with a coating of mortar. Should the slightest earthquake occur, the mortar cracks and the wall falls. Now, for the construction of a picture the movements of the canvas or the panel are terrible earthquakes. The pomades used for getting out the embus do not penetrate deep enough to fill up the vacuums formed. A new mortar, must therefore be filtered into those little catacombs, and for this work petroleum is useful.

Shall this mortar consist of oil?

We said above that there was quite enough of oil in the colours. Its being badly distributed is no reason for using more of it; it is better to take *normal resin* which will give solidity, preserve and even increase transparency, without the yellowness and darkness which time always produces with oil.

For this purpose it is well to use resin dissolved in petroleum; if this resin dissolves well cold in oil, it is because all the pores will remain shut up by this resin if no re-painting be done, and should re-painting be done, the oil dissolving this resin which shuts up the pores will be able to become rooted.

This ought to explain how everything intended to get rid of the embu, which is not soluble in cold oil, is altogether disastrous. In fact, the want of adhesion makes the picture scale off, and is most disastrous to it.

By observing carefully all the precepts given above, an oil painting may be executed under the best possible conditions for durability, and the maximum of brilliancy and freshness can be obtained from the colours.

CHAPTER X.

THE PRESERVATION AND RESTORATION OF PICTURES.

ONCE upon a time there was a little dealer in Swiss articles : villas, cuckoos, milkmaids and mountaineers of white wood. But, this style of thing being no longer the fashion, the little dealer, in spite of his intelligence and courage, saw his business on the verge of ruin. One day, when no longer able to pay his landlord, he was obliged to forfeit all his goods to him.

He took refuge, sad and desolate, in a lodging which he took in a hurry. Fortune at last, compassionating his distress, sent to his lodging a messenger in the form of a servant from a large house. The servant thus addressed him : "Sir, the Count, my master requires your services. I have spoken to him of you, because in the neighbourhood I was told that you were the nearest. I might have gone to look for another, so I hope you will not forget my little commission—all the more so as the Count is generous, and if you deal with him properly, his business may amount to some thousands of francs. We understand each other, do we not ? I shall say that you are coming directly."

The servant ran joyously downstairs, leaving the unhappy little dealer perfectly stupefied, unable to understand what this unknown Count could expect from him.

Still, hypnotised by the words "several thousands of francs," he mechanically took up his hat and stick to go out.

As he shut the door, the mystery was revealed to him. There it was! *Expert*, engraved in beautiful black letters on a brass plate. This plate and the title of expert belonged no doubt to the former occupant.

Might he appropriate them—profit by this mistake? Oh yes! A drowning man does not trouble about where the plank which saves him comes from. So, putting remorse behind him, that is if he had any, and resolving to profit by this opening, he had recovered his composure when ringing the Count's door-bell. The servant, who expected him, ushered him into the drawing-room, announcing with dignity: "The Expert!" His fate was thrust upon him—he was an Expert! But expert at what?

It was the Count who informed him. First the Count wanted to have his opinion about the authenticity of several old pictures, then to have some of them re-varnished, and afterwards to ferret out the works of promising young artists. For the Count had decided partly to renew his picture gallery. He considered the old masters full of merit, but he thought that an amateur should also interest himself in contemporary artists, and that it is more interesting to discover them when rising than to follow with the applauding crowd when past their primer. (We see that the Count possessed intelligence far above the average.) Finally, he counted upon the enlightened assistance of the learned Expert to help in realising his plans. The Expert approved in every respect of the Count's ideas; but he asked, before giving a formal opinion, if he might study the pictures a little nearer . . . It was a serious matter! . . . etc. In short, he played his *rôle* admirably well, and when they separated, the Count and the Expert were mutually pleased with each other.

Next day, the Expert's brass plate, brightly polished, shone

like the sun on the door of the former dealer in Swiss articles.

He knew already that he was doing no harm by keeping the title, as it is one which anybody may take. He took into partnership a picture restorer, as he was ignorant of the first step in his new business. He attended sales, visited artists, and in a short time he became a most important personage in the commerce of pictures.

This anecdote, perfectly authentic, is to show how indifferent certain amateurs are as to the competence of the people to whom they confide works of whose great value they are perfectly aware.

Were it a question of a valuable dog or horse, those same amateurs would not only call in to attend them a properly qualified veterinary surgeon, but they would require a substantial guarantee as to the skill of this Esculapius; whereas for the care of a picture the first comer will do.

We do not wish to depreciate experts in general. Some of them are profoundly learned in their art, but there are others quite ignorant. What we blame is the thoughtless selection that is made from them; all the more so that the pictures abandoned to their care have often damages much greater than varnish worn off. They might be repaired, for restorers exist who are masters of their art and do wonders; but if they fall into unskilful hands, they are irretrievably lost. And our indignation is roused to think that the support of a minister, the recommendation of friends in good positions, is enough to cause the treasures of our museums to be scoured by such hands.

The end of this will be, that no one shall be allowed to take the title of expert in pictures without having passed regular examinations, such as are passed by lawyers and doctors.

This would not give to all experts great skill, but it would at least prevent any from being altogether ignorant.

We have left the picture carefully done and substantially constituted. But on leaving our hands, its own life begins, and that is sometimes a hard one.

The pictures which are not appreciated are the least to be pitied, for, as we have just seen, it is especially from the attentions bestowed upon them that pictures suffer most.

The first operation to which they are submitted is varnishing.

Varnish is the dress of the picture ; it preserves it from destructive emanations, it protects its surface, it enriches its colours, and when it is faded, soiled by contact with impurity, frayed, yellow, blackened by time and smoke, altogether worn out, it is taken off and a new one is put on. Clearly, it is a dress ! But a dress fitting so closely that we might almost call it a skin, and a skin cannot be changed like a dress. Each time that a picture has the varnish taken off a little flesh comes with the skin. Unless very great pains are taken the process is one of flaying. Wishing to have the pictures ready too soon, they are always varnished too fresh, in which case the varnish penetrates yet more into the painting. We are not going to speak as did a celebrated practitioner of "the varnisher's art" ; yet to varnish well requires great care and long experience. (*See APPENDIX—"Varnishing."*)

When the picture is varnished, it may be left alone for some years ; but it is seldom so lucky.

Amateurs have a habit, when looking at a painting, of making a circle with their finger to indicate the part which they admire.

The little circle is imaginary ; but not so the knocks from the admirer's nails. It is even fortunate if the excited

patron does not hold a lighted cigar or a metal eye-glass too near the picture.

Sometimes the admirer will even rub the remarkable place with a little saliva. The remarkable place consequently becomes of a dark blue colour, and the darker it gets the more the washing with this nicotine saliva is repeated. So that, if the picture contains many remarkable places, it soon becomes quite disgusting.

When the amateur leaves home, you might expect that the picture would have nothing more to suffer. Ah, but yes! Servants do not take the trouble to draw down the blinds, when the sun is at its zenith, and, during the summer months the unfortunate picture receives every day at the same hour a burning ray of sunshine, under which the varnish swells, to crack afterwards as it cools. And the great cleaning days! the knocks from feather brushes, whose broken feathers scratch it in all directions. And the flies! it is really quite remarkable how they always collect on the lightest places, not exactly to eat the picture!

Then, winter comes back, with its cigar-smoke and coal fumes and general admiration; until some day the amateur gets tired of the picture (which is very likely!) or perhaps a tempting price is offered him for it, or he has losses in business, or . . . he dies! At any rate, sooner or later, the picture changes owners; then the expert appears, which always means cleaning and re-varnishing. Poor picture! There are unscrupulous people who, to get on faster, instead of taking off the varnish with the finger, use alcohol, which takes off the painting, or they even re-varnish it without cleaning it, for we cannot call what they do to it cleaning. We have seen a very celebrated expert wash all the pictures in a gallery, estimated at some millions of francs, with the same wash-leather and bucket of water; the dirt from the

pictures of Rabens passed over to the pictures of Teniers, and so on, but all were as dirty at the end as at the beginning.

The precautions to be taken for the preservation of pictures are, therefore, to varnish them carefully with good varnish, to protect them from all abrupt changes of temperature, and from any chance of being touched, or knocked about, and to keep them always in a state of the greatest cleanliness, that the taking off of the varnish may be seldom necessary.

But a picture may contract other maladies yet more serious than being merely dirty. These maladies come sometimes from causes in the painting itself when that has been carelessly done.

The maladies inherent to painting are of two kinds :

1. Change in the colours.
2. Defective solidity in the colours on the support.

The change of colours is due to two kinds of causes :—

1. Chemical causes ;
2. Physical causes.

The chemical causes of change in colours are the influence of light, which makes them fade or change tone, and the reaction which produces and destroys their combinations.

This reaction is mostly the result of contact amongst themselves, or with oil, varnish, etc., which fix and cover them, or with the gases contained in the atmosphere.

All the alterations proceeding from these chemical causes are irremediable, and often by trying to cure them the existence of the picture is compromised.

As for the changes which have physical causes, they are occasioned by the presence of gluten and disorganised varnish, which, placed over each other, darken the colours without changing their nature, or sometimes by defective

drying causing cracks, etc., or any other accident which may interfere with the continuity of the painting.

The physical changes are reparable with intelligent care.

The want of solidity in the colours on their support may be owing to the destruction of the support under the painting, or to the lack of adhesion between the support and its sizing, or between the sizing and the painting.

The destruction of the support is produced: if it be a panel, by dampness which rots it, or by worms which devour it; if it be canvas, by dampness which rots it, or by oil which burns it.

The want of adhesion of sizing on a sound support arises always from the sizing being of bad quality; either it has been affected by damp, or it has become spoiled in itself; but in either case there is no adhesion amongst its particles.

The want of adhesion of colours on the sizing is the result of the same causes. The roots thrown out by oil will not hold in a sizing without consistency; the repeated stretching of the canvas, as well as the play of the wood, hasten the catastrophe. The repair of all these accidents necessitates two operations: re-canvassing, done by gunning a new canvas behind the old one to consolidate it; and transferring, which consists in taking the painting completely off its panel, canvas, or even off its wall to transfer it to a new panel, canvas, or wall.

Let us say at once that when such operations are deemed necessary they should be done by professional repairers; we have some who are true artists—extraordinarily clever, and who have done the work of restoring in a manner more wonderful than any painter could have done. We venture to advise to those restorers the use of caseine paste, to the exclusion of gelatine or rye pastes, which are much more susceptible to damp.

Trivial accidents, such as split or bruised canvas, blistering of paint, caused by excess of heat coming either from the sun or a stove, little creases, slits occurring during the execution of the picture, through any neglect of requisite precautions, in short, all the accidents of the craft, daily occurring, the artist himself should be able himself to repair; and to do this he will find the simplest and most practical means described in the Appendix ("Repairing of Small Everyday Accidents").

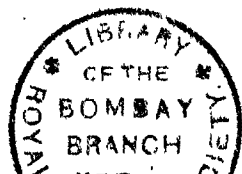
CLEANING.

Pictures sometimes only require to be cleaned.

In all cases, they should be cleaned before re-varnishing, and the complications to be met with are not always easy to foresee.

Besides dust, smoke, and all the other impurities with which paintings become covered in course of time, it is difficult to imagine all that the caprice of different owners may have put on it: egg varnish, oil scumbling, bacon rind, vaseline or other grease, burnt wax, carriage varnish, etc., even collodion.

Each of these substances requires a different solvent, and we require a drug store at our disposal to clean perfectly certain pictures which perhaps may be only a few years old. (See APPENDIX—"Cleaning.")



CHAPTER XI.

WALL PAINTING.

For the style of painting called fresco painting, one of the earliest in use, the sizing is of lime or mortar coloured with paints ground and distempered with water, and applied whilst this mortar is still fresh.

The colours penetrate into the mortar, and the solidity of the painting depends upon that of the sizing itself.

The colour does not leave the sizing, but often the sizing leaves the wall.

The wall to be painted is first entirely covered with mortar made of lime and sand, put on about an inch thick; this first bottom layer making a rough surface is called rough-casting; over this rough-casting the sizing proper is applied composed also of lime, but less coarse, and of finer sand. Only as much as can be painted that same day is prepared at once, and the painting is only done when the sizing is sufficiently set to bear the pressure of a finger without sinking. Long-haired brushes should not be used, as they are apt to stick in the lime.

Re-touching is not possible. The sized part that has not been overtaken during the day, and any parts that may have been spoiled, must be demolished down to the rough-casting, and recommenced next day.

In truth, it is a barbarous and inadvisable process, only spoken of here because it holds a high place in the history of art, and we owe to it several masterpieces. But the

bad condition in which they are, to speak only of the frescoes of Raphael and Michael Angelo, when compared with pictures by the same masters executed in egg or oil, does not do much to recommend a style of painting so difficult to do and whose results are so limited. It is true that means have been proposed and even tried for making fresco painting easier to manipulate and to re-touch, by mixing with the colours paste or mucilage enabling it to be resumed the following day; but that is really like distempering in egg, fig or cheese paste, etc., according to the material employed. The paint thickened and kept back by the substance added to it can no longer penetrate into the mortar, thus diminishing its durability, and it is then quite useless to paint over the line, as it may destroy certain colours. Only those whose use is applicable to the process should be employed, *i.e.* carbonate of lime, white earths, enamel and ultramarine blues, smoke black. Cinnabar, or vermilion may also be used, but they must be prepared with lime-water, and that diminishes their brilliancy.

Wax has also often been used for painting walls; but on walls wax is not sheltered from damp, and that causes it to powder.

The oil and wax painting invented by Taubenheim seemed for some time to be an improvement; but the same causes spoiled it, and simple oil painting is now used, but with no better results.

The question has not been properly gone into. All painting, good on canvas or panel, would be so on a wall; when the painting is bad, the wall is blamed.

It has been thought that this difficulty might be got over by putting complicated sizing on the wall. In fact, the colours do hold better on these sizings than on stone, but the sizings themselves disintegrate and fall.

There is only one way of preparing a wall to make it suitable for preserving painting, *i.e.*, to size it with resin on condition that the resin penetrates deeply into it. Besides, stones get very easily permeated with resin, and then become so hard that iron tools can scarcely break them. Here is the process: First, instead of carefully filling up all the joints and holes with cement, which sooner or later always gets loose and falls off, you should, on the contrary, thoroughly clean all the interstices, and put bare stones everywhere. Afterwards dry it as much as possible by means of a chafing-dish passed up and down before all parts of the surface.

When the wall is thoroughly dry and still warm, give it a first coating of resin dissolved in volatile essences, and when this varnish is set, by means of heat make it penetrate into the interior of the wall, repeating the coatings of varnish in the same way, until the stone refuses to absorb any more: and only then fill up any holes with a mastic made of the same varnish, fine sand and wax. The last is applied hot, with a glazier's knife. The wall thus prepared is now ready to receive the sizing you select as suitable for the kind of painting that you intend doing.

Should oil painting be chosen, first apply a thick coating of re-touching varnish which, adhering by affinity with the resin already imbibed by the wall, will serve as a link between it and the sizing that you will next apply, composed of white lead ground in oil and distempered with painting varnish.

If wax painting be the style that you choose, the sizing must be composed of zinc-white ground with essential oil of petroleum and wax dissolved in re-touching varnish; this sizing being dry, should be heated so that the materials of which it is composed may incorporate properly with the resin in the wall.

Finally, should it be water colours that you choose,—yes, water colours, and that would be the best process,—the sizing must be composed of resin and zinc white, ground together with water : four parts of resin to five parts of zinc white by weight. After being applied and having dried, it must be heated so that the resin in melting may assimilate with the zinc white (*see* chapter on Water Colours,—“Water Colours fixed by means of fire”).

This sizing may be rubbed when quite cold with pumice-stone powder and cold water, and other coatings can be applied above, until the surface becomes as smooth as semi-vitrified porcelain of dazzling whiteness.

Over this hard sizing you should paint with colours specially ground with a solvent and glycerine. Those colours keep fresh for months if desired, and if you wish to dry them you have only to heat them : the solvent melts like the enamel of earthenware, and when all is cold, after a few minutes' interval, wash with fresh water to take off the superfluous glycerine. Re-touches are always possible, and the painting is indelible, almost as flat as pastels. It may be washed with black soap or potash, and resists the most violent acids. This process may be applied to all sorts of materials. We had invented it to do water colours on wood and even on paper. We shall have occasion to speak of it again. (*See* chapter on Water Colours,—“Water Colours fixed by means of Fire.”)

It is very easy to add wax to these colours, whether in painting or afterwards, rendering the wax invisible with water by means of ammonia (*see* APPENDIX—“To render wax miscible with Water and Glycerine”); in this case, it is melted with resin after using the hot chafing-dish, and the painting obtained by this means resembles the wall paintings of Pompeii which are always, although wrongly, called frescoes.

There is still another means of decorating walls besides painting them: that is, to cover them with painted canvas. In this case the canvas is pasted on the bare wall, or on the oil sizing with a paste made of oil and white lead, or with rye paste. This operation is called priming.

It is better to prepare the stone with resin, as we said above, and to mix picture-varnish with the oil of white lead. The use of paste for this kind of work is absolutely bad.

On walls thus imbued with resin, especially in halls or theatres where there is much emanation from gas, you may, by means of water-colour fixing, paste paintings executed in water-colours on paper, which, afterwards covered with several layers of the same fixative, would be as solid as earthenware, and as easily cleaned, for neither potash, acids, essences, nor even benzine, can attack these pictures.

With these processes, which are not crude dreams, as for eight consecutive years specimens of them have been shown at each exhibition of French water-colour artists, we no longer ought to see what we have hitherto seen: master-pieces covered with smoke in the lobby of the Opera House, which if cleaned at all must be done by rubbing with bread-crumbs for fear of spoiling them, a process at once expensive and insufficient. What is wanted is a commission of competent men thoroughly to study these methods, and if approving of them, recommend their use to artists, who should upon certain conditions bind themselves to use them. Is what we desire impossible? Impossible is a word that we are told is not in our language. Alas! we always find it in a question of administration.

CHAPTER XII.

CRAYONS, DISTEMPERING, EGG-PAINTING, WATER BODY-COLOURS.

WHEN colours are ground merely with water, it is the medium of cohesion added to them to make them stick on the support, paste, gum, etc., that seems to determine the numerous different styles of painting to which this principle has given rise. But it is rather the quantity of mediums than any difference amongst them which causes the variety of processes. In fact, as the proportion of medium increases, the transparency of the colour increases also, and the aspect of the painting is no longer the same.

In classing, then, these processes by degrees of transparency, we begin with the crayon, which is not transparent, and in which the colours contain so little medium, that they remain in a state of powder.

Next comes distemper, which is a half pastel. There is only a very little medium in it, but yet sufficient to obtain rather more solidity, and rather more transparency. Then come water body-colours, and egg-painting, in which the quantity of medium continues to increase. We arrive at complete solidity, but not at the utmost possible transparency. Ultimately, with transparent water-colour, the quantity of medium always increasing, we can arrive at a maximum of transparency almost equal to that obtained by varnish.

The mediums used in these different processes, having all the same solvent (*i.e.*, water), and generally having much affinity amongst themselves, can be easily mixed. Consequently, there is nothing to prevent us from using several of these processes for the execution of the same picture. We can thus arrive at uniting all the qualities of opacity and transparency desired; but the solidity, for instance, will not be equal in all the parts, and it is impossible to establish it uniformly, for reasons which we are about to give, in connection with the never-ending question of fixing crayons.

CRAYONS.

These colours are ground with pure water. The clay added to them (generally pipeclay) is sufficient to preserve them in the form of a stick when they are dry. Those which do not contain clay are ground with water very lightly gummed.

It is then in a state of powder that they are put on the support—paper, cardboard, canvas, etc.—and they are only kept on it by mechanical means, so it is necessary that this support should have a rough natural surface, or that it should be made so with a layer of pumice stone or powdered sand mixed into some kind of paste.

There are some useful points to indicate in the preparation of supports destined to receive crayons. Amongst the numerous causes of destruction in this kind of painting, the two principal are that the powdery colours easily leave the surfaces on which they are stuck, and that not being protected by any gluten, they, more than any others, are susceptible to damp and to emanations from gas.

Now, the supports generally chosen for painting in pastels are those most conducive to its destruction. Canvas or

paper stretched on a frame is quite a sponge for dampness, and at the same time a drum which every noise and the rolling of carriages keep in a state of perpetual vibration, the result of which is to make the powdery colour come off quicker still. On the contrary, such materials should be chosen as are little vibratory, and rather thick, *e.g.*, cardboard, and secured from damp behind, and in front, either with water-colour fixative, or with painting varnish. To this some people will object that to paint in crayons on stiff objects is very difficult, that crayons break easily, readily crumble, and that the flexibility of the stretched paper or canvas is more agreeable. It is a question of lightness of hand; but as some people are unwilling to let a requirement of solidity disturb their habitual customs, there is (*see* APPENDIX—"To prevent the Vibration of Stretched Canvas or Paper for Crayons") a means of stiffening canvas and paper stretched on frames, after the work is finished. Pumice-stone powder, sand or powdered glass, which give roughness to supports, should also be applied by means of impervious materials such as fixative or varnish, and not with a susceptible paste liable to putrefy.

If the cardboard used be thin, it should first be floored to increase its stiffness.

We may give to the crayon a little more solidity than it has naturally, but to fix it completely is not to be hoped for: that is quite impossible without destroying the velvety look, which is its principal quality.

To explain this it is useful to refer to the physical laws of light.

The parcels of colouring matter which constitute crayon colours are all in a free state, kept together merely by pressure of air, and held on the support by natural or accidental grapples, which catch on its rough or velvety surface, for the

power of the slight gluten which keeps them in sticks is broken directly the sticks are rubbed.

These parcels reflect, by *diffuse reflection*, the quantity of white light, and the uncoloured rays of the decomposed light absorbed, which determine their proper colour, increase in intensity by the fact that they reflect each other. Further, these parcels often have smooth surfaces, which reflect the white light by *specular reflection*. Those of the surfaces that are placed at a propitious angle of incidence, send direct to our eye the light which they thus reflect; the others send that light on the neighbouring parcels, which are thus further lighted, and their luminous intensity is consequently increased. All the reflections, diffuse and specular, from the parcels reach our eyes through a transparent homogeneous medium—viz., the air in which they are themselves bathed.

All these parcels cannot be fixed except by uniting them by some glutinous and transparent material. This material, in order to penetrate easily through the powdery colours, ought to be in a solution, but slightly concentrated in a volatile liquid without influence, and, whether it be applied behind a spongy object, or sprinkled in front by means of a spray, it will penetrate, attracted by the vacuum, through the interstices which separate the parcels, according to the laws of capillary attraction, and will come to accumulate first round those which are nearest to the support.

If this material is in small quantity so as only to seize the parcels in the lower part of the layer of colours, it will solidify them without the appearance of the crayon being thereby changed, because those imprisoned parcels are just what we do not see; but the upper part of the layer will not be fixed.

If we increase the quantity of glutinous material so as

to-reach the surface of the layer without covering it, the solidity will naturally increase, since all the parcels will be laterally bound by the agglutinative—that is to say, they will be bathed in a transparent medium of greater density than air, and there will be produced, for the upper parcels that we see, new effects of *refraction* which will somewhat modify the sensation that they produce; but the external surfaces of the parcels which are the most visible not being yet covered by the agglutinative, and consequently continuing to give the first sensation, the general aspect of the crayon will be little changed.

At this stage a distemper is being made of it: it no longer falls in powder when shaken, but still it comes off when rubbed; if required to fix it entirely, the quantity of agglutinant must be increased until it covers all the upper parcels to a sufficient thickness.

Then these parcels are quite drowned in a transparent medium thicker than air, and they change entirely.

This brings us to the aspect of a water colour more or less impasted.

The crayon is quite fixed, but it has no longer either its velvetiness, bloom, or dull softness; it is no longer crayon.

So, in fixing crayon, it is better to stop short at half-fixing, corresponding to the consistency of distemper.

This process is especially good for outlines and foundations, which thus acquire a comparative solidity, and can spare a little of their bloom as they will afterwards be re-painted. A mistake is made, in using for this purpose fixatives with a basis of gelatine, which they all have, from the first invented by Latour more than one hundred years ago, to the most recent—which, privately, is exactly the same.

A substance is thus introduced into the colour that

attracts damp and causes fermentations of which the result is often the loss of the crayon whose guarantee is desired.

Only incorruptible and impervious substances should be used as agglutinatives.

Now, be quite convinced of this principle—that, whatever the process of painting used, the results arrived at will be the same.

By grinding any pigment with petroleum as well as with another volatile liquid, either alcohol or water, the petroleum once evaporated, that pigment would be crayon. By adding an agglutinative soluble in petroleum, oil or resin for example, in a very small quantity at first, the pigment would take, when once dry, the consistency and appearance of distemper; and in proportion as you increased the quantities of oil or resin, you would see solidity and transparency increase.

In short, whether the pigment be ground with more or less of any agglutinative, or whether more or less agglutinative be made to penetrate into a layer of colour already laid on, it comes to the same thing, and there is no getting out of this dilemma:—either the colour remains in powder and is not solid on the support, or an agglutinative is added which solidifies it, but then it is no longer in powder nor has it any longer the qualities of crayons.

The colouring-matter used for crayons should be the same as those considered substantial for other kinds of painting. Carbonate of lime may even be used. It gives a desirable white, in the sense that it is not affected by gas emanations and cannot be used with oil because it does not adhere.

Unfortunately, manufacturers of crayons are induced more than any others to give unsubstantial productions, because with these same carbonate of lime whites dyed with aniline dye, they obtain crayons of a good consistency and of magnificent tones, but which fade on exposure to light. It

would be well, therefore, for these colours, to exact the same guarantees as for oil colours, and to be particular about knowing whether, in the mixtures made by the manufacturer to prepare the gradations of broken tones which he presents to us, there be no substances liable to produce chemical reaction on each other.

DISTEMPER PAINTING.

In this process the pigment is ground with water and distempered in painting with animal gluten, rendered liquid in a *balneum*. We shall only just mention this style of painting, which is scarcely ever used except for theatre decorations.

It is not the object of this book to teach all the different styles of painting which it describes, but merely to give to artists, whom we suppose to be already experienced, the means of rendering their work more durable. Therefore, why stop to consider a process which is only used by some of them for outline work, especially as we consider this use of it bad and only desire to dissuade them from using it? In fact, as distemper is much too absorbent to be re-painted in oil, a preliminary layer of oil or varnish should be put on, and this darkens the distemper considerably, because it always resumes the tone that it had when wet; all the benefit of its characteristic quality of freshness is thus lost. A good plan is to increase the quantity of paste, thus making of it a water colour in paste, instead of in gum.

In this condition it is less absorbent and does not change tone under the layer of varnish or fixative, with which it should be covered before painting in oil. Only, gelatine in so large a quantity has the fault of scaling off; and as, for other reasons already explained, we exclude it from sizings, why bring it into outline work?

Cheese paste, which has not the same inconveniences might be used, but of it also a large quantity would have to be put.

Now, as we have just seen, it is not the kind of paste or gum used which makes of a painting distemper, or water colour: it is the quantity put in. In distemper, the quantity of paste is so small that the parcels of colouring-matter are held together without being covered; in water colours, on the contrary, the quantity of gum is large enough for the parcels to be completely drowned in it.

Then with gelatine or cheese paste or gum, you can graduate from distemper to water colour.

Well, it is in water colour, and not in distemper, that outlining should be done, *i.e.*, with much paste or gum in the colour; and as gum-arabic is more transparent than paste, we prefer it for this purpose.

As for those authors who have written that Veronese outlined in distemper, they have not stated definitely the precise use of the word, and from this mistake have come all the unfruitful attempts which have been made to recover this process of the Venetian masters. Yes, they have outlined in paste, but with sufficient paste for the sketch to be transparent and impervious to oil in the necessary measure, as water colours are, and not floury and absorbent like distemper.

WATER BODY-COLOURS.

Opaque water colour is merely distemper; only its colours are distempered with gum-arabic melted in water, instead of animal gluten. We have, therefore, nothing more to say on this subject.

EGG PAINTING.

This process, one of the most ancient, lends itself to a great many combinations. It may extend from distemper to water

colours, *i.e.*, from the greatest opacity to the greatest transparency; and as it allows the addition of resins and of wax, it may acquire a solidity which oil painting will never have.

Formerly the colours were ground with water, and distempered with yolks of egg fresh emulsioned with cold water (this is egg distemper); to this was sometimes added natural white of egg or albumen to increase transparency. To introduce resins, they were first dissolved in essence and as varnish mixed with the egg, either directly or emulsioned with water.

To introduce wax, it had first to be rendered miscible with water, through the medium of an alkali, and at that time only one was known—viz., lime.

It is by cleverly-used mixtures that those paintings of the middle ages were obtained, which have stood out for many centuries on damp walls, and which have often been mistaken for frescoes. Similarly, many pictures on wood, copper, slate, or other materials painted in the same way, have been looked upon as oil paintings. The reason of this mistake is that, in these paintings the flesh shadings have been so harmoniously finished that they could only be done with a viscous paste long malleable, like oil colour, but the painters of the middle ages obtained these same results by directly triturating the yolk of egg without water, but with resin; the oil contained in the egg dissolved the resin, and colours dissolved with this paste had absolutely the consistency of oil painting.

To-day, if we seek to imitate this style of painting, it is not necessary to take eggs; it is easier to analyse the materials contained in those mixtures and, by taking only those which are useful, thus reproduce this ancient process.

What is there in an egg?

The yolk and the white.

What is there in the yolk?

There is some vitelline, analogous to caseine, an oil, besides some sulphur and other materials that we need not consider.

What is there in the white?

Albumen and other matter not required for our purpose.

To reconstitute the useful parts of the egg, we therefore only require caseine, oil of egg, and albumen. We can introduce into it resins by dissolving them directly in oil of egg, introduce into it wax with volatile alkali (ammonia), which transforms at the same time caseine into paste; and we have then the egg painting, re-made chemically and purer than before, since we have not the useless parts of the egg—amongst others, sulphur, which would even be destructive, if used with white lead. A painting executed by this process is extremely solid, especially if covered over with a final varnish of good quality. For this purpose we might try a varnish composed of *normal resin* dissolved in egg oil in the proportion of two-thirds resin to one-third oil. As this varnish would be much too thick to be used, it might be applied with volatile petroleum, which, once evaporated, would only leave the oil and resin. But this varnish dries very slowly, it remains sticky for weeks, and it would be necessary to keep the picture sheltered from dust during all the time it was drying; therefore we do not give this formula as a very practical one.

Oil of egg can also dissolve copal, and decomposes it much less than any other oil, because the boiling point of egg oil is just the same as the disintegrating point of copal— 37° Centigrade—and the copal being well immersed in the boiling egg oil, cannot thus be brought to any higher temperature.

The solutions of copal in the egg oil are uncoloured, and there is no loss of weight.

Varnishes thus obtained are therefore much stronger than those of linseed oil, and do not get yellow.

All this, as we have said in connection with egg oil, is perhaps prospective, but, for the present, no one has yet studied this question, for the few experiments that we have been able to make cannot be instanced as a sufficient study. We have, alas ! been unable to continue our experiments, for the never-ending reason that life is short, and that to undertake everything is a sure way to accomplish nothing.

CHAPTER XIII.

WATER COLOURS.

WE have at length arrived at water colours.

Under this name is meant, to-day, a very complex style of painting which includes impastements, opacities, and transparencies. It is, in different proportions, a mixture of the ancient paintings on missals with opaque water body-colours and washes. All these styles of painting, which have, for liquid, water; and for agglutinative, gum-arabic, are of the greatest antiquity; but water colour properly so called, which is only a wash in colours, and where the paper is reserved for the lights, scarcely dates back beyond the beginning of this century; for the artists who, before that time, used washes for their sketches, confined themselves to a few neutral tints which never went beyond a camaïeu. Of all kinds of paintings that can be done with colours ground with gum, having the same causes of destruction and requiring the same care for preservation, we shall not make special articles; we shall confine ourselves to giving the necessary instructions for doing water colours in general, in a substantial manner.

PAPER.

Water-colour paper should be made only from linen rags, and should be bleached only by the action of pure water, air and sunshine; but it is very seldom that such is to be found.

Cotton is introduced into it and, as it is sold by weight, kaolin or other heavy substances. To bleach it, chlorine or other chemical agents are used, which burn the linen and are often destructive to the colours.

The sizing, which prevents it from being too absorbent, should be equally distributed in the paste and not put on the surface just at the last ; otherwise, as soon as the outside gets worn out by prolonged work, the inside is found to be irregularly spongy, and this causes stains. Not only the paper should be dry when used, but it should never have suffered from damp from the time of its manufacture, because then the sizing ferments, decomposes and loses its properties.

English manufacturers, to whom we are indebted for all water-colour requisites (one scartely knows why!), send enormous quantities of their paper into France, and, for reasons of economy, the goods are conveyed to Paris by water ; so that sometimes the paper remains for weeks at the bottom of the hold in the ships, when arrived at the quay.

Besides, the business being carried on by wholesale dealers, the latter, when they receive the reams of paper, heap it up on the ground floor of warehouses, sometimes even in cellars, until the paper is delivered over to the customers. After that the paper dries : but it is spoilt.

We should either make our paper ourselves, which is not practicable, or a society of important artists should arrange with a manufactory (everything tends to this) to obtain paper in good condition.

Whilst awaiting this golden age for artists, there is only one means of getting good paper ; and that is by choosing it. A paint box should be taken to the colourman's, the trial of a sheet of paper there made and, when found suitable, a stock of it should be bought.

Paper well preserved, in a dry place, at a moderate temperature, does not spoil: on the contrary, it improves.

As for any observations that you might make to your colourman for him to repeat to his dealer, thence to pass by the traveller to the manufacturer, they would be only trouble wasted. In this respect paper is not alone: it is the same with every other article; and the objections of artists, even when of high reputation, are of no more importance to these gentlemen than are the cries of the sheep in the slaughter-house.

GUMS.

The pigments for water colours are ground with gummed water; but the choice of the gum is of some consequence. Gum-arabic was excellent for this purpose, unfortunately it can no longer be used; for the very good reason that it is not to be had.

How?—it is not to be had! All the druggists sell it.

Yes, they sell a gum which they call arabic.

Is it then false?

It is false in one sense, *i.e.* not being the genuine, it is false; but the genuine, no longer existing, there cannot be any false. And then, such as it is, it is imitated. It becomes then genuine, since it is imitated.

If this somewhat strained reasoning suffices to quiet the consciences of the druggists, their gum-arabic is none the less very different from that of former times. It is obtained from the same kinds of acacias, that have been planted in Senegal and elsewhere, but which are no longer in the same climatic conditions.

It is supposed that in Arabia the gum of these same acacias owed its particular qualities to the heat of the sun to which it was exposed for a long time on the trunks of

trees ; and that the trees could only support the high temperature of the country by the help of subterranean rivers in which the trees plunged their roots. The explanation is that these rivers are now dried up and become so finally ; in the countries where the gum acacias grew, they have now totally disappeared. It is certain that heat is a necessary agent ; for, by subjecting the gums of Senegal to high and progressive temperatures in stoves ; chemists have now succeeded in restoring some of the qualities of the old gum-arabic.

It is then understood that none but the gums of Senegal and other provinces are found in the commerce of to-day, and that those are the gums which are made suitable for water-colour painting by subjecting them to a preliminary treatment.

In these gums there is naturally much variety, and also counterfeit imitation. Some of them contain no gum at all.

Here is a specimen : From dextrine, gelatine or other cheap materials melted in water, a thick paste is prepared which is passed through a strainer with holes of unequal diameter, the edges of which are roughened with a pointed file ; the paste comes through these holes by its own weight, and the drops have their surface marked with stripes like the true gum. When the pieces are dry they are broken, and there is the gum !

Is it sufficiently Arabic ?

It is necessary that the water colours should be easily spread on the palette ; but at the same time they should be sufficiently insoluble for it to be practicable to put a second tint over a first without taking the first off.

This correct degree cannot be obtained for all colours with the same gum. For almost all the gum that has been through the stove is necessary, because it distempers easily ;

but with others, the natural gum of Senegal is preferable, and for others such as emerald green, for instance, dextrine must be had recourse to.

Chromates render the gum insoluble; and emerald green, when not well manufactured, is affected in this way.

The colouring materials that may be used for water colours are the same as for oil painting, and equal care should be taken to make sure of their purity. (*See APPENDIX—"Verification of Colours."*)

In the water colours of commerce we find one great fault, especially if it be desired to use them for outline work to be afterwards filled up in oil; they are not all equally gummed.

To obtain this equal gumming, the colours should be tried whilst grinding and gum added to them until the colour, when dry, has not the same tone as when wet. Once arrived at this equal gumming, colours imbibe no more at one place than at another.

Artists, according to their tastes, like colours more or less damp; and to satisfy them large or small quantities of honey or glycerine are added: sometimes even sugar is had recourse to; but all these have drawbacks: first, the sugary matters attract dampness; if there is any excess, the colours get so soft that, often, some water colours in a box stick to each other.

But it is not only dampness which sugar attracts: it also attracts flies, and the harm which they do is irremediable. They leave everywhere, in the colour of the fresh tints, marks of their visits like so many little touches from a microscopic sponge. We have once seen a woman's head, very beautifully shaded, attacked by flies, which made her appear as if she had had smallpox.

Often, to facilitate execution, especially for large pieces

like skies for instance, very rapid drying is not desired, and it is necessary to keep the paper damp. For this a little glycerine may be put into the water, but very little; or a solution of gum tragocanth or of chloride of calcium may be used. Some ancient miniaturists used for this purpose the slime of snails or the juice of the figtree; but all these means are more or less efficacious; and are not without danger.

Nearly all substances which take a long time to dry, only possess that quality, thanks to the affinity which they have for water: this affinity with water gives them the power of retaining it for a long time, but also that of resuming it very quickly, and might transform water colours into barometers.

A liquid should be sought which should have no affinity for water, but which should naturally evaporate much slower than it. We have found this liquid; it has even the advantage of taking an hour to dissolve gum, so that the top can be re-painted without dissolving the bottom, and one may shade in full paste, as in oils, for several hours.

If, after having worked thus for some time, you desire the work to dry up quickly, by putting the water colour in the sun or before the fire this famous liquid will evaporate in a few minutes.

Only (there is an only) this liquid is not an article of commerce; at present it is but a curiosity of the laboratory, and actually costs £12 for a quarter of a gallon.

This is not very available.

Let us hope, however, that its production at a reasonable price may soon be arrived at, and that water-colour painters may be able to utilise this marvel—for it is one.

In the process of water-colour painting, the uppermost colours adhere perfectly, as the second layer distempers the first and mixes with it. The only precaution to be taken

for solidity during execution is to avoid impastements. Should white have been used and a light tone be wanted instead of a dark one, instead of thickening the touch until the dark tone has no more effect by transparency, it will be preferable to wash it off first; and on the unpainted surface, even if soiled, much less impastement will be required to obtain the same tone.

Water colour does not contain in itself anything which can change or destroy it; but it is affected by the action of the air, water, and many other accidents, and if complete solidity be required it should be fixed.

FIXATIVE.

Why, some people will ask, should water colours be fixed? They are generally protected by glass, and it is not usual to wet them with water. To this we might answer that an excess of precaution can never destroy, and that it is well to preserve them from any possible accident. But the fixative has another object. Water colours, even under glass, are often spoilt by many causes. The dampness which penetrates into the paper, facilitating the fermentation of the gum with which the colours are ground, causes the formation of microscopic fungi. The painting is then said to be getting rotten or sticky.

Excess of heat, produced by the proximity of a fireplace or the rays of the sun through glass, brings the gum to such a state of dryness that it scales off in imperceptible quantities, and leaves the paper, taking the colour with it. The water colour is then said to fade: as an art critic remarked, it forms a breakfast for the sun.

Now, the object of the fixative is to prevent the sun from breakfasting upon water-colours, and dampness from cultivating fungi on them.

Penetrating deeply into the paper, it surrounds the gum and the colouring-matters with a transparent cement, always supple; as hard as glass, incorruptible and quite impervious. It cannot be attacked by any acid, so that colours which cannot be used habitually, because of the influence of the gases in the atmosphere spoiling them, remain, when thus protected, perfectly solid. Besides these two destructive agents, dampness and dryness, which the fixative paralyses, water colours may be ruined in other ways. If left exposed to air, the paper gets yellow in time. Even in a box they catch dust, and even under glass coal smoke reaches them and spoils them. The fixative remedies all this. The paper does not get yellow when the water colour is fixed, and, however dirty and greasy it may become, washing with a clean soft sponge, water and black soap restores its brightness and freshness.

These are the services which fixative renders to the amateur anxious to preserve the water colours which he buys and which he loves.

But to the artist, whom modesty forbids to care about the duration of his works, fixative offers other advantages in the help which it gives to his work.

The whole or part of a water colour may be fixed in the course of execution, to be retouched afterwards above, and that several successive times.

With a dissolving liquid the whole or part of the fixative may be withdrawn from a water colour which can be restored to what it was before the fixing, so that any amount of re-touching is possible. (See APPENDIX—"Manner of withdrawing the Fixative.")

In a case where the colour did not take easily on certain parts of a water colour already fixed, it is only necessary to put with a paint brush a little dissolving liquid on the parts,

and to let it evaporate. The colour will afterwards take readily.

The fixative is, besides, an infallible detective of the bad quality of any colours which should be banished from the palette.

In order to be convinced of this, it will suffice to put on paper specimen touches of all the colours and to fix them, or merely pass above them some dissolving liquid; all those which contain aniline or gamboge, and consequently are detestable because unable to bear light, will dissolve in the fixative and should never be used.

WATER COLOURS FIXED BY FIRE.

We have spoken, in connection with wall painting, of process which might be used for water colours.

This process, to which we have given the name of fixed water colours (*see* APPENDIX—"Commercial guarantee"), can be used on paper, wood, or stuff, and all materials that can resist the degree of heat necessary for fixing them—*i.e.*, from 120 to 150 degrees.

The colours enclosed in tubes can be preserved indefinitely, and on the palette remain fresh for months; when used they are dissolved with water, or with half water and half glycerine, if required to be kept a long time fresh whilst working.

If left to dry on paper they take the appearance of crayons, but they can be again dampened by means of a vaporiser, and when fixed by means of heat they resume the appearance which they have when wet.

The fixing is done by means of a spirit lamp furnished with a bent tube, the orifice of which is moved about in front of the picture; when the colour takes a shining

appearance under the influence of heat it is left to cool and washed in plenty of water to take off the glycerine. This washing can be done under the tap of a fountain, or with a sponge pressed over the water colour, so that the water flows vertically, or, if the object is not very large, by plunging it into a bucket of water several times. Then it is allowed to dry naturally, or the drying is hastened by a lamp held pretty far off, and when all trace of water has disappeared, the lamp is brought nearer; at the time the water colour is somewhat pale, and it resumes its colour perceptibly in proportion as the heat increases.

When all the colours are restored to their primitive tone, the water colour is fixed. It may then be painted over without any fear of melting anything; it may even be washed with a sponge like an oil painting; only it must not be rubbed too hard because it is not merely the colour that would come off but the paper which would tear like any wet paper much rubbed.

Wax may be introduced into this painting. The wax is prepared by dissolving it in glycerine with ammonia (*see* APPENDIX—"To render Wax miscible with Water and Glycerine"): the solution keeps quite well in bottles.

The wax thus prepared mixes with the colours whilst painting, but the best plan is to apply a layer of it before painting.

When this wax has been used once in a water colour it will be necessary to apply a layer of wax every time that it is wished to repaint it, because the heat of the fixing makes it melt and the new colours will not adhere to it, but with this layer of prepared wax they adhere perfectly.

The use of this process requires some practice, as may be understood, and in heating there is a knack of hand to be acquired; but when one is accustomed to it it is very

easy to do, and the results—of a perfect solidity—hold a middle place between crayons and water colours. It is well to reserve some paper for lights, so as not to be obliged to put impastements of white, and the white should be oxide of zinc, for the carbonates of lead or lime do not bear the necessary heat of fixing.

When the water colour thus made contains no wax it may be varnished with a light egg varnish, and over that with re-touching varnish, fixative, or picture varnish.

Water colours without wax may also be varnished with gum-lac, dissolved in water with borax (*see APPENDIX*—“Gum-lac”).

When the water colour contains wax, it is preferable to confine oneself to passing over it a layer of wax prepared with glycerine, and heating it; the wax melts; and the glycerine springs to the surface in tiny drops like lye; a light washing takes it off at once, and a final heating unites the whole by spreading the wax equally over all the surface.

When this process is used for coloured substances, such as wood, cardboard, etc., it is well to cover them with a sizing which produces a white surface. In this case to avoid washing and double heating, the white of zinc should be prepared in water without glycerine, and put on very evenly with a swallow-tail; when this sizing dries, naturally it will be powdery like crayon, and one heating will be enough to fix it.* If in the course of the work it be wished to change some parts of the water colour already fixed, to get a white surface so as not to impaste, the piece to be taken off should be done with a linen rag saturated with the dissolving liquid (water-colour fixative), and afterwards with water. Over this place a layer of water-colour zinc-white should be put, to

* The zinc-white ground in water contains the flux which is to be fixed by the heat.

reconstitute the sizing. If it is on paper that is useless : for after one washing in the dissolving liquid, the paper will be found quite white.

These colours may be mixed with gum, in which case less glycerine should be used in the grinding, and they should be moistened with pure water. They are used just as in water colours, and after being heated there is no need to wash them, as there is no glycerine to take off.

Colours fixed by heat are more waterproof than those in pure water colours, but are not altogether impervious, as they contain a little gum.

It is true that recourse can always be had to fixing them with fixative, but then it must be done rapidly, and the same place must not be done over several times, because the fixative dissolves the other materials which unite the colours with the gum.

WATER COLOURS IN SARCOCOL.

We have sometimes used sarcocol for uniting the pigments in water colours. Sarcocol is a gum resin soluble in water and in alcohol.

It was known to the ancients, and was much used in early times, especially in Italy. Pliny speaks of it in his day as a substance very useful to artists and to surgeons (we may infer this from its name); bandages were saturated with it, and used to bind up wounds. Being replaced in pharmacy by cerecloth, and artists not having used it for several centuries, it is to-day difficult to obtain; still it can be got, and nature furnishes an abundance of it; it only requires to be harvested.

After being gathered it must undergo some preparation to discolour it and extract the sarcocolline, which is the only part to be used. (See APPENDIX—"Sarcocolline.")

Colours ground with sarcocolline, which acts like gum, are of an extraordinary richness and colouring intensity. They have the advantage of softening much less quickly than those ground with gum, consequently allowing glazing over water body-colours, and rendering the superposition of tints much easier. On the other hand, they have the inconvenience of being scarcely soluble when once dry on the palette, and the tenacity of this gum resin is so great that in drying it takes off the enamel from paint-boxes and leaves the tin bare.

They can therefore only be used easily by keeping them damp in little bottles with large mouths, whence they are taken with the point of a knife. In this way they can be easily kept, by being careful to put occasionally, half water and half alcohol into the bottles, the presence of the alcohol preventing fermentation.

These colours may be moistened with water mixed with alcohol in various proportions, and even with pure alcohol. We have thus a water colour drying very rapidly, which is sometimes very convenient, especially with objects more or less waterproof, on which the tints in pure water have a tendency to melt, and to run into each other. Indeed, it is all the more useful that, on materials which absorb little or none of the superfluous liquid used to lay on the colour, this liquid evaporates all the quicker for being but slightly absorbed.

Colours in sarcocolline, moistened with alcohol, have also the advantage of adhering very readily to greasy surfaces. By this means, painting in water colour may be done over foundations painted in oil. This process is very speedy, and produces wonderfully powerful effects.

It is very convenient for the decoration of inhabited rooms where the smell of oil paint is feared; and it gives a very

substantial painting, especially if covered with wax or varnish, according to whether a dull or shining effect be desired.

This kind of water colour cannot be fixed with the fixative, because the alcohol which the fixative contains would dissolve the sarcocolline ; but it is easy to prepare a fixative which would not have this inconvenience.

One word more, for those water-colour painters who have the bad habit of sucking their paint brushes : sarcocolline has a bitter taste, something like aloës and similar medicinal qualities.

Finally, all these processes may lend each other a mutual aid, according to the style of work ; we have often mingled several, and sometimes all, together in the same water colour ; but strict attention must be paid to their respective qualities and to the different methods in which each should be fixed.

CHAPTER XIV.

CONCLUSION.

IN finishing this book, we shall repeat what we said in its preface. It was not our object to write a treatise in order to teach artists that which they know as well as ourselves, nor to teach amateurs that which they can only learn by the help of a professor. We have limited ourselves to trying to destroy the prejudices of ignorance, the destructive practices of routine, and to furnishing to those artists who are willing, the necessary instructions for making the best use of their tools, for procuring substantial materials, and for using them in such a way as shall let their works remain for the longest possible time in the condition in which they leave them, whatever may have been the processes used to produce them.

The hope that this book will be useful to those who will read it is very natural, but we have still the ambition to believe that it will have good results, even for those who will not read it.

The kind reception which the pupils of the School of Fine Arts have given to the lessons on the material processes of painting, and the diligence with which they have attended to them, prove that they begin to be no longer indifferent to those questions; and our pupils—in them lies the future!

The taste for science coming always in proportion to the

study given to it, we shall soon see the young generation occupied in seeking for lost traditions, and in applying themselves to profit from the lessons of the past. Already the Society of French Artists has appointed a committee which will render, we hope, immense service.

The bad fabrication of the materials used by artists is an acknowledged fact, and the idea of remedy is beginning to become general; to-day this question is considered, and yesterday it was thought good form to ignore it. On all sides symptoms manifest themselves of an approaching reaction against ignorance; we see coming a psychological evolution which shall lead painters no longer to blush at knowing their business; and the moment is not far off when a gentleman who shall say in a drawing-room "I do not care what becomes of my pictures after they are sold," will be thought as pretentious and as ridiculous as would be an architect if he made light of the solidity of the monuments entrusted to him to construct.

This roving school on the fields of fancy has lasted long enough. Therefore let artists resume the ancient route traced by the old masters: they will find there noble examples to follow. Rubens, one of the most learned men of his time; Vandyck, a distinguished chemist; Leonardo da Vinci, engineer and mathematician; Michael Angelo, painter, architect, sculptor and poet, and so many others, have well proved that knowledge does not destroy genius.

Let us hope, then, that science and painting, after having been so long separated, will remain closely united in the future, as they have been in the past, and we shall then consider as a great reward of our work, that we have been somewhat instrumental towards that result.

APPENDIX.

THE COMPOSITION AND MANIPULATION OF VARIOUS PAINTS.

WE have collected into this Appendix all the practical directions necessary to those artists whose love of the science is great enough to induce them personally to make trial of the precepts which this book contains.

But we do not venture to hope that this part of the book will find many readers; and by thus calling attention to it, we almost acknowledge beforehand the dulness which is inseparable from it.

To all those readers who find that statements of figures put them to sleep, to those ultra-refined beings to whom manual work is distasteful, to those lazy brains whom the slightest attention fatigues, to the superficial minds who take no interest in serious things; finally to all those who only read in order to amuse themselves, we are conscientious enough to say before they turn this leaf: "Beware!

Abandon all hope of amusement! or go no farther! We are about to teach!"

Good and Bad Paints.

CHINESE WHITE OR WHITE LEAD (CARBONATE OF LEAD).

Formerly this was obtained by a process (called the Dutch process), which was as follows:—

Pieces of lead soaking in vinegar were put into earthen

pots, which, ranged in shelves, were buried in ditches the bottoms of which were filled with refuse straw and stable manure. The acetic acid of the vinegar formed with the lead acetate of lead, which was changed into carbonate of lead by the carbonic acid escaping from the dung. By chemical agency the same result may be obtained in a laboratory.

Since that time white lead has been prepared by solution. This is called the Clichy process. The white thus procured is not entirely free from the water used in its preparation, and it does not cover a surface so well. In reality the white which is used, is made by processes almost similar to those which are the secret of the manufacturers ; but as the chief object of the manufacturers is to produce an article at the lowest possible price, so as to prevent competition, they have thus arrived at monopoly of production in some articles, so that being unable to procure any other, the artist must content himself with such white as he can get and that is frequently not of a proper consistency.

It is the same thing with other colours : manufactures on a large scale have extinguished private industry ; and now, in order to obtain paints suitable for artistic painting, it would be necessary either for artists to make their paints themselves (which would be impossible), or for them to arrange to have manufactured for them paints especially for their use ; and this, we hope, will soon be realisable.

Carbonate of lead, by means of vapours of sulphuretted hydrogen which are often sent abroad into the atmosphere, forms sulphur of lead which is black. It is thus that certain water body-colours and certain white pencils, made of carbonate of lead, become of a more or less dark grey shade. One may by moistening them with oxygenised water cause them to return to their primitive whiteness, because then the

black sulphur of lead becomes a sulphate which is white. But if such an accident occurs in a painting, the remedy is of no use because the presence of the oil and varnish is an obstacle to the said transformation.

Nevertheless, white lead or Chinese white remains, for the time, necessary in oil painting; because it is the only kind which adheres.

It must be banished from all encaustic or other processes requiring the help of fire, because it decomposes in any heat exceeding 100 to 120 degrees. Neither must it enter into any combinations which might contain sulphur, as that would blacken it, nor acetic acid which decomposes it,—as for instance in a distemper, where one would use the cold paste very liquid, to avoid the trouble of the water bath.

ZINC WHITE (OXIDE OF ZINC).

The white of zinc is procured by vapours of zinc oxidised by a current of air.

It is not alterable like white lead, but it does not acquire with oil the same solidity; it remains more brittle, is spent more easily and does not cover so well. Yet one can give it more body by compressing firmly powder of oxide of zinc by the hydraulic press before grinding it, or also by grinding first this powder, and with water making it into cakes and drying them in a stove. Zinc white may be used in all kinds of painting: it is indispensable for mixing with vermilion, to the exclusion of white lead, and also for mixing with cadmium, should there be any fear about the manufacture of the latter.

Finally, it is an excellent substance and very agreeable to use on all those occasions when, employing much white on the support by way of light, much impasting is not required.

SPANISH CHALK WHITE, TROYES CHALK WHITE, BOUGIVAL
CHALK WHITE, MEUDON CHALK WHITE, CARBONATE
OF LIME.

All these whites are solid when used with water, but when used with oil they become grey and transparent and never dry thoroughly; therefore they should not be used even for water colours, when painting in distemper, water body-colour or any other kind of painting that is to be varnished or touched-up with oil.

Like carbonate of lead, they do not bear strong heat, and like it they decompose with acetic acid.

EARTHS, OCHRES, MARLS, IRON LAKE.

All these colours, consisting of oxide of iron more or less calcined, naturally fixed on clay or artificially on alumina, are perfectly solid; but the catalogue of them is difficult to limit, for different kinds of coloured earth are constantly found.

We mention here some of the colours most extensively met with.

When we say that those colours are good it is understood that their genuineness is first to be proved; for it is not enough that they are called by the names which we are about to give, it must still be proved that they are what they ought to be—viz., oxide of iron.

Italian earth,
Natural and burnt sienna,
Red earth,
Rose earth,
Yellow earth,
Foundation ochre.
Red ochre,
Prussian red,
Venetian red,
Antwerp red,
Nuremberg red,

Indian red,
Colcothar or crocus martis,
Vandyck brown,
Red brown,
Mars yellow,
Mars orange,
Mars red,
Mars violet,
Mars brown,
Iron lake.

It is quite understood that this list cannot be complete. Oxide of iron is presented and will continue to be presented under many other names until artists shall insist upon its bearing merely its true name.

ORANGE AND YELLOW COLOURS.

We have classed separately those earths, ochres, and marls which are yellow, red, and brown, because those substances form a distinct category ; but all the other kinds of colouring matter, whose chemical formulas are different, we shall class according to their colour, so that they may be more easily recognised, desiring it also here to be noticed that it is impossible for us to give a complete list of the numerous fancy names with which the prospectus of an artist's colourman is covered. In the first place we do not know them all, and before this book is printed many others will have appeared. We limit ourselves to the best known.

Lead, in combination with other bodies, furnishes many yellow colours more or less bad. Such are :—

Certain yellows of a lemon shade (iodide of lead).

Chrome yellows (chromate of lead).

Orpiment, king's yellow (arsenite of lead), obtained also by sulphur of arsenic.

Mineral yellow (on a basis of oxy-chlorure of lead).

Minium

Mineral orange } protoxide and bioxide of lead.

Saturn red

Straw yellow

* Mineral turpeth } subsulphate of lead.

All these colours get black or decompose the metallic combinations with which they are associated.

* The subsulphate of mercury, also called mineral turpeth, could not be used in painting.

The following are also bad :—

Ultramarine yellow (chromate of baryta).

Certain yellows of the chrome kind made with chromate of lime and all the mixtures bearing the pompous names of

Green Naples yellow,

Brilliant yellow,

Buttercup yellow, etc.

The following vegetable yellows are also bad :—

Saffron yellow,

Gamboge.

And all the yellow lakes which fade on exposure to light and are changed by certain metallic combinations :—

Wold lake,

Yellow lake,

Yellow alumina,

Golden yellow lake.

We have said what we had to say about Indian yellow : it is a fairly substantial colour, but it requires to be very carefully ground so as not to be soluble in water, whilst, owing to its alkaline properties, with oil it forms a kind of soap. As we can very well dispense with it, being able to replace it admirably with iron lake and cadmiums, we always think it wiser not to use it. Naples yellow (lead antimony) and antimony yellow (lead antimony and lime silicate) are two substantial colours, but very seldom pure and very often badly made ; and as they are also not very useful, we have excluded them from the palette.

The following are solid yellow colours :—

Orange cadmium yellow

Cadmium yellow

Light cadmium yellow

Lemon cadmium yellow

} sulphur of cadmium.

Before mixing the light shades of cadmium with white

lead, it will be well to ascertain that they do not blacken, which would happen if, being badly made, they contained an excess of sulphur.

The following are good to use as yellow colours :—

Ochres, earths, marls, iron lake, chromate of strontian and cadmium yellow.

The firm of Lefranc & Co. now make an orange of a superb tone which may be very useful ; this colour, a combination of coal acid and naphthaline, is perfectly solid, but it must be used alone and, above all, not mixed with white.

RED COLOURS.

The following are bad :—

Realgar (Sulphur of arsenic) blackens and decomposes metallic colours.

Scarlet (Iodide of mercury) fades in the light.

All the lakes obtained by cochineal fade in the light :—

Carminc,
Lake Carmine ;

or those procured by dyes from woods of Pernambuco, Brazil, Campeachy, etc., under whatever names they may be presented, as well as those which are due to aniline dyes :—

Geranium,
Nasturtium, etc.

The madder lakes are comparatively substantial.

The following are also good :—

Cinnabar	} Sulphur of mercury.
French Vermilion	
Chinese Vermilion	

but care must be taken never to mix them with lead whites, but with zinc white only.

Red colours good to use are therefore all the earths, ochres, and marls, vermilion and madder lakes.

BLUE COLOURS.

The following are bad :—

Mountain blue (carbonate of copper).

Berlin blue

Prussian blue

Turnbul blue

Antwerp blue

Celestial blue

Turquoise blue

Mineral blue

} different combinations — formula, Ferrid
cyanide of iron.

All these blues of the same origin are decomposed by the majority of metallic oxides and disappear when exposed to light; some, however, reappear in the shade (excessive modesty).

Still bad :—

Indigo (a vegetable substance which gets black and green from contact with greasy bodies).

The following are not bad, but useless, as they can be replaced, and grind badly :—

Pompeii blue (double silicate of copper and lime).

Azure blue

Smalt blue

Saxony blue

Starch blue

Blue of Zaffre

} double silicate of potash and cobalt.

Enamel blue (known to the ancients as Alexandria frit).

The following are good :—

Cobalt blue

Dresden blue

} Combination of aluminum and oxide of cobalt
obtained at a high temperature.

Ultramarine

} Combination of silicate of aluminum, silicate
of soda, and sulphur of sodium.

Ultramarine badly made may sometimes blacken Chinese white; a preliminary trial of it should therefore be made unless the artist is very sure of its quality.

Blue colours good to use may therefore be reduced to two, which, besides, are quite sufficient: Cobalt and ultramarine.

GREEN COLOURS.

The bad are:—

Prussian green (double salt of cyanure of iron and cobalt; turns to a grey-red in the light).

Verdigris (acetate of copper).

Scheele green } arsenite of copper.

Mineral green }

English green } mixtures of chrome yellow and Prussian blue.

Green cinnabar }

Green lake (mixture of woad lake and Prussian blue).

Schweinfurt green (arsenite of copper and acetate of copper).

Vienna green (arsenate of copper).

Bladder green, a lake made with buckthorn dye, and iris green are also bad owing to their want of substance.

Green earth is also not to be recommended; it does not adhere. As for malachite green, or mountain green, or Bremen green, or Hungarian green, it is very scarce and difficult to grind. It is well imitated under the name of Brunswick green. The true malachite green is substantial but none of its imitations are. Veronese green is an arseniate of copper of a particular make; it may be used on condition that it is left by itself and carefully covered with varnish to avoid any contact with other colours.

The green colours which are really good are:—

Cobalt green (oxide of cobalt and oxide of zinc).

Emerald green (oxide of chrome).

VIOLET COLOURS.

All the violet colours obtained by aniline are bad, such as:—

Magenta violet,

Solferino violet, etc.

Vegetable violet obtained by dye of Campeachy wood

mixed with salts of lead, and violets derived from cochineal are also bad.

An ultramarine violet is now made which is as solid as ultramarine, but does not adhere well and to which for that reason we prefer cobalt violet (phosphate of cobalt and silicate of cobalt), and especially mineral violet (phosphate of manganese). This last colour, very solid and adhering well, is especially useful; it may be had in two different shades, both equally good.

Therefore, for violet colours, preference should be given to cobalt violet, mineral violet and Mars violet.

BROWN COLOURS.

Amongst brown colours the worst of all is bitumen. It fades in light, melts in heat, causes the painting to crack, runs and compromises the existence of all the pictures in which it is used.

Next comes Cologne earth, which is only wood in a state of decomposition.

Cassel earth, chicory brown, and natural or burnt umber (bioxide of manganese), are also bad. Umber is penetrating and blackens all the tones with which it is mixed or over which it is laid.

Prussian brown (calcined Prussian blue) is completely useless, as it may be advantageously replaced by Mars brown, which is excellent as a covering brown.

Imitation bitumen, of which we have spoken and which we have the honour to present to artists under the name of *Vibert brown*, will give an excellent transparent brown, having all the good qualities of bitumen without its defects. This colour, perfectly substantial, is a mixture of lithanthrax and oxide of iron on an aluminum basis. Brown colours, therefore, should be limited to Mars brown, and *Vibert brown*.

As for blacks, as we have said, they are all good, except those which contain tar.

VERIFICATION OF COLOURS.

Unless one be a chemist and have at his disposal the various requisites of a laboratory, it is impossible to make a complete analysis of colours. But with the simple materials that are always at hand, either in kitchen or studio, the colours when pure may be verified and their principal adulterations may be discovered.

The following is a list of the necessary materials and objects. They are neither numerous, costly, nor difficult to procure.

Strong vinegar.

Kitchen salt (in wet solution).

Copper water. (This can easily be prepared by purchasing from the grocer some oxalic acid in powder and making a solution by dissolving it in water.)

Aquafortis. Composed of one part nitric acid to five parts water.

Soda crystals in a wet solution.

A spirit lamp.

Some little glass vases and funnels, some paper filters, and an iron spoon not tinned.

The colour to be analysed should first be reduced to powder; if an oil colour, it should first be dissolved in a glass of benzine and allowed to settle, the liquid then gently poured off, and the process repeated with new benzine. This should be done several times, until all the oil be eliminated and the powder which remains quite free from grease: it should then be put to dry on blotting-paper.*

*. We insist on the colour being completely free from grease, because in the reaction obtained by fire any trace of oil would give rise to smoke, which might cause an error.

If the colour to be analysed be a water colour, the same process should be gone through with water to remove the gums, honey, glycerine, etc. In any case the liquid which comes off must not remain coloured, as that would indicate the presence of certain aniline colours.*

It is therefore quite understood that, in all the following operations we treat the colours as in a state of dry powder and perfectly free from grease.

WHITE LEAD OR CHINESE WHITE (CARBONATE OF LEAD.)

Put into a glass a small quantity of the white, and pour over it about six times that amount of aquafortis. If the white be pure, it should dissolve entirely, with effervescence: an insoluble residue would indicate the presence of sulphate of baryta. To this solution add a large quantity of kitchen salt in solution, it will form a precipitate white which is lead. Filter, and to the liquid which comes off clear, add a solution of soda crystals until the bubbling stops. If a precipitate white be formed, it shows that the white contained oxide of zinc or carbonate of lime.

ZINC WHITE (OXIDE OF ZINC).

Oxide of zinc should dissolve in vinegar: if a very heavy white residue remain which falls at once to the bottom of the glass, it shows that the white contains sulphate of baryta. When the oxide of zinc is dissolved in the vinegar, add the solution of salt (twice the volume of zinc) the liquid should remain clear: if it form a precipitate, there is carbonate of

* Sometimes the colours are ground so fine, such as ultramarine for example, that the water remains coloured for a long time, and patience is required until the deposit is properly formed.

lead. Put back some of the clear solution of oxide of zinc into the vinegar, dilute it with fifteen times its volume of water and add some copper water, about the same volume as there was of the zinc: the liquid should still remain clear; if there be a precipitate, it shows that the white contained carbonate of lime.

STRONTIAN YELLOW (CHROMATE OF STRONTIAN).

Put the chromate of strontian into a glass with ten times its volume of aquafortis: it ought to dissolve entirely. The solution becomes orange-coloured if a solution of salt be added to it; should it precipitate a yellow residue, that would be chrome yellow.

CADMIUM YELLOW (SULPHUR OF CADMIUM).

Put the sulphur of cadmium into a glass with four times its volume of nitric acid: it ought to dissolve; the solution is milky, and a certain quantity of sulphur floats on the top. If the solution be more or less grey, and after the deposit the purified liquid be coloured a greenish blue, it shows that the sulphur of cadmium contained chromate of lead; if the residue be of an intense red, it shows that it contained vermilion.

VERMILION (SULPHUR OF MERCURY).

Heated in an iron spoon, the sulphur of mercury should be completely volatilised. Should a residue remain it shows that it is not pure. Put to boil in water and filter when boiling; the clear liquid should not, on cooling, precipitate any red powder: that powder would be iodide of mercury.

MADDER LAKES.

Madder lakes boiled with a weak solution of crystallised soda give a red colouring; cochineal lake would give a violet

colouring. The solution of crystallised soda should be made with thirty times as much water as lake and an equal quantity of crystal and lake.

Lakes which colour alcohol contain aniline. Whether or not they will bear light should be ascertained.

ULTRAMARINE.

• Ultramarine should dissolve cold in ten times its volume of copper water cleared with sulphuretted hydrogen (smelling of rotten eggs). The solution is of a milky grey, but without the slightest tint of blue; should there be any blue tint it contains Prussian blue.

Heated in the iron spoon, the ultramarine whilst burning should not emit any vapour of a beautiful purple colour, that would show that it contained indigo: these vapours have a strong and characteristic smell. Ultramarine is rarely adulterated with indigo.

COBALT (OXIDE OF COBALT).

Cobalt put in a glass with ten times its volume of copper water should preserve the same tone that it would have in pure water; boiled, and left to settle for an instant, the floating liquid should be uncoloured. If it were blue, that would indicate the presence of Prussian blue.

If it emitted an odour of rotten eggs, that would indicate ultramarine.

Cobalt should get red in the spoon without vapour, like ultramarine.

EMERALD GREEN (CHROME OXIDE).

Boiled with pure nitric acid emerald green should not change; if water be added and the liquid strained it should

be uncoloured. If it be yellow, it is from the presence of chromate of strontian, lead or zinc. Boil the emerald green with copper water; after it has settled for a short time, if the liquid on the top be coloured blue, that shows it contains Prussian blue; heated in the spoon, it should emit no vapour; should it emit a white smoke with an odour of garlic when put on a red-hot spoon, that would show that it contained arseniate of copper.

COBALT GREEN (OXIDE OF COBALT).

This is like emerald green, only it dissolves entirely in aquafortis mixed with water and the solution when pure is of a light pink. The solution will be orange if it contain chromates or does not entirely dissolve; Prussian blue would remain at the bottom if there were any.

BLACKS.

All blacks which are the product of carbonised animal or vegetable substances, when kept red-hot for an hour in the spoon, will leave an amount of ash equal to the amount of black paint.

Lamp blacks leave little or no ash.

EARTHS (OCHRES).

These colours are not generally adulterated; impurities they contain vary in degree; the only deception practised is to enrich their tones with aniline dyes: by putting them into alcohol we can at once see if the alcohol colours.

CLEANING.

To clean a picture, the first thing to do is to wash it with lukewarm water and a soft sponge to take off the dust and coal slag from its surface.

Afterwards, if it is varnished, the varnish may be taken off with the finger, washing it from time to time and leaving it to dry before resuming the de-varnishing until there is no longer any dust to be felt under the finger. Then put on a little essence of petroleum, applied with a linen rag the surface of which must not be fluffy: the picture is then ready to re-varnish. But if under this varnish first taken off there is another which does not yield to the finger, or if this first varnish itself does not yield to the rubbing, there would be every reason to suppose that we had come to an oil varnish or an ordinary varnish over which some kind of greasy matter had been passed. The picture should then be covered with essential oil of petroleum, and at the end of twenty-four hours a layer of finely powdered chalk passed through a sieve should be sprinkled over the oil on the picture laid horizontally. The object of this chalk is to suck up the petroleum charged with fatty matter. Twenty-four hours after this operation, the picture should be washed with lukewarm water to take off the chalk, and afterwards with water slightly soaped to finish taking off the grease.

If these means are not sufficient, it may be washed with acetum and water, but it should be cautiously done, and first tried on a small corner to see the effect.

After each washing, the finger should always try to de-varnish; if, however, the varnish persists in not coming off, we may be sure that there is an oil varnish. In this case it would be dangerous to try and take it completely off—it would be necessary to try alcohol or benzine, which would attack the painting. We must be satisfied with taking off merely the surface with acetum and water and a silk rag, and doing only a very small part at once; or it may be done with egg oil mixed with the dissolving liquid of water-colour fixative. But if, under this varnish that we do not wish to

take entirely off, the picture seems very dirty, the reason is that this varnish had been applied over coatings of old grease, which happens very often. In such a case what is to be done? It must be taken off; but there is a risk of destroying the picture, and the best thing to do is to entrust it to the care of a restorer who will only do what you would do yourself, but who will do it more cleverly. In any case it is always a hazardous operation.

To take off the colour from dried oil on a picture, either in part or entirely, a rag soaked in benzine, or even a scraper, should be used. On an unpolished panel this last means is good, but on sizings or paper, benzine is preferable; with it there is no risk of making either holes or scratches.

VARNISHING.

Before varnishing a picture it should always be washed in lukewarm water, as said above, and left to dry thoroughly.

Next the picture should be placed horizontally, and a first layer of essence of petroleum applied (it is indispensable that the picture to be varnished should be sufficiently dry) and immediately afterwards the layer of picture varnish, applied by passing the swallow-tail brush evenly from right to left and left to right, until the entire picture is covered with varnish, after which repeat the operation with the swallow-tail from top to bottom and bottom to top, so that the passage of the brush may have been everywhere crossed. At the end of an hour the picture may be placed upright, and two hours afterwards the varnish will be sufficiently dry to prevent any dust adhering to it. This would not be the case with essence varnishes, as they remain sticky sometimes for days.

For varnishing dry weather should be preferred, and the

work always done in a room warmed at least to twenty degrees. As a matter of course all precaution should be used to ward off dust during the two hours required for drying.

At all times, when from any cause a picture has been washed with water, it should never be left wet, but gently and thoroughly dried with a silk rag, to prevent the dampness from penetrating.

WATER-COLOUR FIXATIVE AND THE DISSOLVING LIQUID.

The object of the dissolving liquid sold with the fixative is to liquefy the latter when too thick. It is also useful to take off the fixative when desired, and to wash the paint brush after the fixing.

METHOD OF FIXING.

When required to fix a water colour it should be laid flat and one or two coatings of dissolving liquid applied with a flat or soft brush. The paper being thus saturated, the fixative will be better distributed over all the surface, and will penetrate better into the interior. Before the dissolving liquid evaporates a layer of fixative should be immediately applied with the same brush, going over it first one way and afterwards crossing it, as in varnishing.

It should be left to dry in the air, and at the end of some minutes or a quarter of an hour, according to the temperature, the liquid having evaporated, the water-colour will be sufficiently fixed to allow new tints to be painted without melting those below; if a more complete fixing be desired allowing the water-colour to be washed freely in water, a second layer of fixative should be applied, but this time without the preliminary layer of dissolving liquid. Besides,

the need of this second layer will be greater or less according to whether the fixative has been applied thick or thin, or whether the paper has been much or little sized.

Only one bit at a time should be fixed: e.g., a part already shaded that is to be glazed at leisure, without fear of melting what is below it, or, on the contrary, a flat tint over which the shading can be done without destroying the local tone beneath.

METHOD OF TAKING OFF THE FIXING.

To withdraw the fixing, a layer of dissolving liquid should be applied, and it should be afterwards sponged with linen or blotting-paper but not rubbed, so as not to wear off the colour nor grains of paper. This operation should be renewed until all the fixative comes off, which may be ascertained by trying on a corner if the colour melts readily in water. This de-fixing is useful in certain cases. First, although it is quite easy to paint over the fixative, sometimes it is desirable to retouch by washing in order to accentuate the lights, and it is necessary that the colour should melt. Besides, it will often happen that the fixative has only been used in a provisional state as a means of work.

Thus, being satisfied with a head, for instance, the background behind it may be objected to; therefore the head alone should be fixed with a small paint brush and the background washed off all round; but to repaint another background and blend the contours, the head must be defixed. It would be the same if on the contrary the head were to be washed out and the background preserved. The latter should then be fixed and defixed afterwards when the head has been washed off.

When the fixative is used in this way there is no harm in putting a good deal of it, as it will afterwards be taken off.

Sometimes, also, it is very tiresome all the time that a water-colour painting is being done, to reserve little white places like the brilliant buttons of a doublet, the ornaments of a sword handle, the pattern of a stuff, etc., and they are consequently done in Chinese white afterwards; but this method is despised by genuine water-colour painters. If, therefore, they want to do away with these disgracing touches, they have only to border them off with fixative, and afterwards, washing it off they will find the paper white and intact and the touches will remain quite clear.

In this way falling snow may be done, and the method is useful on many other occasions.

Even when a water-colour is not definitely fixed after being finished, the fixative can still render good service during its execution.

VARNISHED WATER-COLOURS.

To varnish a water colour, it should first be fixed; and to know if one layer is enough a little varnish should be applied in a corner over the first layer. If the varnish does not penetrate into the paper, that is enough; if the varnish penetrates, a second layer of fixative should be applied, and so on until the varnish no longer penetrates; then the picture is to be varnished as if done in oils.

REPAIR OF LITTLE DAILY ACCIDENTS.

Indented Canvas.—Wet the canvas behind the place of the indentation with a sponge soaked in lukewarm water and let it dry in a medium temperature.

Blisters.—Soften the blister on the top with an equal mixture of essential oil of petroleum and essence of petroleum; next, pierce it in the middle with the point of a needle, and drop into this hole with a tiny syringe (like those used for dropping medicines in single drops) a little picture varnish. Press with a rag, to flatten the blister and at the same time to take off any superfluous varnish; and afterwards have the canvas pressed under a piece of zinc or glass, so that the borders may be smooth and show no mark. A small piece of paper sized with paste should be put between the glass and the blister, because any varnish which might come out would stick to the glass, whence it would be awkward to get it off, whereas the paper can be taken off with a little lukewarm water.

Splits, Flaws, Cracks.—When the colour is split—which often happens when the repainting is done too soon, especially in a dark tone over a light one—it should be rubbed with a little re-touching varnish and the splits filled up with a knife and a special mastic that we have invented for the purpose. (See “Mastic for Stopping Up.”)

Burst Canvas.—When canvas bursts it is customary to glue behind it a little piece of fine linen saturated with hot melted wax. This is a very bad method. In the first place the wax alone is not impervious to damp, and these mendings often rot. Next, the wax passes to the other side of the canvas through the crack, and as the canvas must always be re-painted to hide the repair, the re-paintings are not substantial, oil paintings (as said above) not adhering to wax. It would be better, before gluing the piece, to apply with a knife a little caseine and zinc-white sizing (see “Sizing of Caseine Paste and Zinc White”). This sizing would prevent the wax from passing through, and instead of pure melted wax, a mixture of half wax and half dammarine resin melted

together in a water bath should be used. This would diminish the chance of dampness.

But the following is another means which we consider much superior.

The picture should be placed horizontally, face downwards, on a slab of marble or metal separated from the painting by a sheet of paper sized with essential oil of petroleum. The edges of the burst canvas should be brought well together by the help even of a flat iron if necessary, being careful to heat this iron only over boiling water.

All the destroyed part should now be coated with caseine paste according to the formula. When the dampness has evaporated a little and the paste feels sticky under the finger, a sheet of paper, thin, but sized, (*i.e.* not blotting-paper, so that the paste may not come through. It should then be well flattened with the moderately hot iron. Not the slightest flaw must remain. All this being dry, a new piece of sized paper should be applied, and a piece of fine canvas rather smaller than the paper, because the canvas would not adhere well to the other canvas. It should be flattened with a warm iron as before; and everything being quite dry, one or more successive layers of re-touching varnish should be applied, letting each layer dry before putting on the next. The varnish should pass the borders of the paper and touch the old canvas, so that the edges of the pieces of canvas and paper are well secured and have no tendency to rise if scratched by anything.

When the last layer of varnish is dry, the picture should be turned and placed upright. If, by chance, the paper sized with essential oil of petroleum which was put between the table and the picture should have stuck, it can be taken off with a little lukewarm water. All that now remains to

be done is to fill up the traces of the crack with filling-up mastic (*see* "Mastic for Filling Up"), or with a little zinc white and caseine paste. A mastic can even be made with caseine paste and a coloured powder of the tone desired.

If caseine mastic be used, it should be painted over with painting varnish and left to dry before being re-painted.

PANELS OF UNPOLISHED WOOD.

Choose the grey or Dutch poplar, because its pores are open and its grain regular. The oak and mahogany have veins some of which are hard and some soft, consequently the oil from the pigments gets more deeply absorbed in the soft veins than in the hard ones, and there results a want of smoothness in the painting which increases layer by layer to the end.

The panel should be rubbed with sand-paper, and for the last rubbing the paper should be soaked in essential oil of petroleum. By this means rays are avoided, the petroleum evaporates and the panel remains smooth without having lost either its grain or its porosity.

The panel should be floored and kept in a dry place until it has shrunk—which will be about one inch in a hundred. Only then should the back of the panel be sized with a flooring composed of equal parts of thick linseed oil and re-touching varnish without siccative, and, when this layer is dry, with another layer of picture varnish. The painting should be done over several layers of white lead, and between each layer the panel should be rubbed with glass paper, and painting varnish with a little siccative should be mixed with the colours. The object of these precautions is to preserve the panel from the attacks of dampness and worms.

PASTE OF CASEINE OR CHEESE.

Take of caseine of commerce, about 20 grammes* according to quantity of paste required. Put it to soak in 100 grammes of cold water for some time. Occasionally it requires to soak for some hours. The length of time depends on the condition of the caseine, which may be more or less hard through drying on the stove.

Whilst stirring, add 4 grammes of ammonia by degrees, stirring with a spatula, or a stick of wood, glass, or horn but not metal. When the ammonia is incorporated with the mixture, leave it alone for some minutes, then stir it anew every ten minutes for a few seconds each time. The mixture thickens gradually, and the paste is ready when it streams from the end of the spoon in a thick syrup without lumps. Still stirring, add 20 grammes of glycerine. Mix well in stirring. The paste is then fit for use. Next day it is still good, but after that it loses its strength and becomes spoilt.

If you have no caseine, and wish to use cheese, the method is as follows:—White cheese (called new cheese), 100 grammes, to which, whilst stirring, add 4 grammes of ammonia, and stir until the cheese becomes paste. Next add to it 10 grammes of glycerine. It is always preferable to use caseine, because, the cheese being more or less drained, it is impossible to judge exactly the quantity of caseine contained in it. The following is the method of obtaining the caseine from the cheese.

Put about 100 grammes, according to quantity required, of white cheese into muslin, and rub it whilst thus confined in warm water, to extract all the watery particles, spread it

* A gramme is about $\frac{1}{4}$ th of an ounce avoirdupois. It is 15.432 grains.

out on blotting paper and let it dry naturally on the stove, but at a temperature below 80 degrees. The caseine thus obtained should be in the proportion of about 12 grammes of caseine for 100 grammes of cheese used.

SIZINGS OF CASEINE AND ZINC-WHITE PASTE

Grind the zinc white in water in the proportion of 100 grammes of water to 100 grammes of zinc, and mix this zinc white with 200 grammes of caseine paste already prepared. This paste should be kept moist with a wet linen cloth over the jar, so that it does not dry. The wooden panel to be sized, having been well smoothed with the glass paper, should be washed with a very clean rag and benzine, to take off any trace of greasy or resinous matters which would prevent the paste from adhering.

When the benzine has quite evaporated, give with a swallow-tail brush, a first layer of paste and white.

Let this dry at a mild temperature. Under the influence of the water contained by the paste, the pores of the wood will open, and, rising up, will become so many little links to facilitate the adhesion of the following layers.

Be careful, when this first layer is dry, not to polish or rub the panel, so as to leave to the wood any roughness which it may have acquired.

Give a second layer. Let it dry naturally, or if wanted quickly, put it in the sun covered by gauze in a room not warmer than 25 degrees, so as not to make the panel crack.

It may then be polished with glass paper or powdered pumice stone by means of a cork or dry rag.*

* According to the manner in which they have been prepared, the zinc whites are more or less dense, and consequently more or less heavy. The proportions given are for the heaviest, which weigh about

If a brilliant white be desired, the third coat may be doubled, or even trebled; but between each coat it must be left to dry and polished.

When the sizing is satisfactorily white, a last coat should be given.

This last coat should be put on very evenly, and so as to require no rubbing, as that would give a disagreeable polish, on which the painting will not look so well.

All the coats should be given thickly, *i.e.*, the brush well charged with matter. As, according to the temperature, the water of the paste evaporates more or less quickly, if the paste get too thick, a little water should be added. The liquid sizing should always come uninterruptedly to the end of the brush when it is lifted out of the jar.

The canvas should be stretched on a frame, and freed from grease with benzine. The canvas should be rubbed with glass paper after the first coating, because the grain of the canvas will always give sufficient adhesiveness, and it is necessary to get quickly rid of the straws, threads, and knots which would interfere with the following coats:

After this first coating it is a good plan to lay on a very light coat of re-touching varnish, which must be allowed to dry thoroughly.

800 or 900 grammes to the litre (a litre = 1.76 pint). Those are the best to use, but there are some like snow-white which only weigh 450 to 500 grammes per litre. Should the latter be used, it is evident that the weight given in the formula should change in proportion. Besides, these formulas can only be approximate. The nature of the wood, cardboard or canvas, desired to be covered, as well as the degree of absorption that the artist desires to obtain, will compel each one to decide for himself the proportion most suitable. The only caution to be given is that each time the coating cracks and lacks suppleness, it contains too much white. Other whites than zinc whites may be used, but in that case the proportions of paste would not be the same.

Second coat, No. 2.

Third coat, No. 3, to be put as desired according to taste, to the thickness of the canvas, and to whether it be desired to preserve much or little grain.

SARCOCOL.

Sarcocol, about 50 grammes, according to quantity desired. Treated by alcohol at 96 degrees, boiling until all boiled away. The distilled alcohol leaves a red residue, soft, looking like turpentine. This residue still contains much alcohol, and is dried in a stove at from 70 to 80 degrees with much difficulty; this is the sarcocolline, of which there will be 35 grammes.

Sarcocolline is soluble in water, except a very small portion which dissolves in sulphuric ether. This watery solution, treated by a solution of acetate of lead, forms a scanty precipitate, which is separated by filtration, and the liquid is treated with sulphur. To eliminate the lead, this filtered liquid is evaporated until dry, and thus a very slightly coloured production is obtained, preserving all the properties of sarcocolline.

It is a glucoside in which a resin is combined with the elements of a sugar.

The alum and acetate of aluminum considerably diminish its solubility without rendering it completely insoluble. Practically, one may be satisfied to put the sarcocol in solution in boiling alcohol. The liquor allowed to cool is filtered, and may be whitened by leaving it for some time in contact with bone black exposed to great light, filtered afresh, and the solution preserved in a well-corked bottle exposed to light.

GELATINE.

To render gelatine liquid (*i.e.* to prevent it from becoming a jelly when cooling), dissolve the white gelatine in its weight of the following liquid :—

Half acetic acid and half water	$\frac{3}{4}$
Alcohol at 95 degrees	$\frac{1}{4}$
Add a little alum.	

To render the gelatine supple, a little glycerine is added, in different quantity according to the degree of suppleness desired.

To add strength to the gelatine, some gum lac may be added to it, either in alcoholic solution, or in solution with water and borax. (*See "Gum lac."*)

Gelatine mixed with linseed oil and our picture varnish makes an emulsion which, ground with zinc white or white lead, makes sizings drying slowly but of wonderful solidity ; when they are to be painted over we do not advise their use, preferring the sizing of caseine paste to them, but in certain cases they may be useful. To render the gelatine insoluble, it should be added to a mixture composed of one part chromic acid to five parts of gelatine or of bichromate of potash and left to dry in plenty of light ; but in this condition the gelatine is of a yellow colour.

If it be desired to preserve the gelatine uncoloured and liquid whilst rendering it insoluble, we prefer the following means :—

Gelatine	1	} melted together in a water bath.
Water	10	
Acetic acid	3	
Acetate of aluminum	3	

Add a little alcohol when all is melted. On all occasions when gelatine contains acetic acid, care must be given not to mix it with colours which are carbonates.

STARCH OR FARINA PASTE.

The starch or farina should be put into cold water, and thoroughly mixed; when the starch or farina no longer forms lumps, put it on the fire, keep stirring, and take it off after it reaches boiling point. Starch paste with gelatine and turpentine (resin) makes a very good paste, that dries quickly.

Boil in water

Starch	100 gr.
Gelatine	50 „
Turpentine	50 „

ALBUMEN.

Albumen dissolves in alcohol, in water and in glycerine; the paste obtained from it may be mixed with gum lac like gelatine and like it, becomes insoluble by acetate of aluminum.

It also becomes insoluble if heated above 100 degrees, when still damp.

DEXTRINE.

Dextrine may be extracted from itself by the following means:—

Starch needles	100 gr.
Water	40 „
Azotic acid	4 „

Make a paste, let it dry in the open air, heat it afterward in a stove for an hour at a temperature of 120 degrees.

GUM LAC.

Brown gum lac dissolves in alcohol, as does also white gum lac, cold or in the water bath.

Brown gum lac dissolves in ammonia cold after soaking.

for five weeks; white gum lac takes two or three months.

Gum lac dissolves also in water by the help of borax.

Gum lac	60 gr.
Borax	10 „
Distilled water	500 „

With very long boiling all the gum lac will dissolve.

Afterwards filtered and evaporated to a syrupy consistency, his liquid is a good deal coloured.

It may be whitened by means of oxygenised water in large quantity.

WATER VARNISH.

Varnishes may be made with water, and have the advantage of being easily taken off with a sponge and some warm water.

GUM VARNISH.

Water saturated with borax. Senegal gum in sufficient quantity according to the thickness desired for the varnish, sugar to one-eighth the amount of the gum, all melted cold and passed through muslin.

EGG VARNISH.

Beat the whites of eggs to a froth with half a piece of sugar reduced to powder for the white of each egg. Leave it to settle for an hour, then draw off the transparent liquid fallen to the bottom of the jar. This varnish does not keep, and must be used fresh.

SARCOCOLLINE VARNISH.

Make a solution of sarcocolline in alcohol at 60 degrees, filtered and purified, with the addition of some drops of glycerine.

This varnish adheres very well over oil paintings, even when rather greasy.

We may also use as varnish a solution of gum lac in water and borax; but this once dry would not come off with water—it would require alcohol.

INKS.

Indelible ink which may be used with steel pens:

Aniline Black	4 gr.
Alcohol	15 „
Gum Arabic	6 „
Water	90 „
Add concentrated hydrochloric acid 60 drops.	

Drawing ink which may be washed.—Good Chinese ink has this property; but where it cannot be procured, it may be made with a solution of gum lac in borax added to aniline black dissolved in alcohol. There is no deposit from this ink, but before shutting it up in a bottle, the alcohol should be allowed to evaporate for a day or two.

TO RENDER WAX MISCIBLE WITH WATER AND GLYCERINE.

Take 10 grammes of wax broken into little pieces, and put it on the fire in 100 grammes of water, or in 100 grammes of glycerine.

When the wax is melted, drop in gradually whilst stirring rapidly some drops of ammonia: the wax will soon become a liquid emulsion, and may be kept in that condition for a long time; the bottle into which it is poured should be left uncorked for several days, so that the excess of ammonia may evaporate.

TO PREVENT VIBRATIONS OF CANVAS OR PAPER STRETCHED FOR CRAYONS.

A wadded mattress should be prepared and placed behind the canvas or paper, and between it and a sheet of cardboard fixed on the frame by screws. Mineral cotton in spun glass or a stuffing of asbestos may be used, as they are both indestructible by fire or dampness.

The cardboard or shelf which is to give resistance behind should be carefully rendered waterproof.

Instead of the cotton, cork or any similar body might be used, provided the body were impervious and very light, and had no tendency to sink to the bottom of the frame, and that its pressure remained equally distributed over all the surface of the paper or the canvas.

INSTANTANEOUS SIZING.

If a sizing be desired which shall dry immediately, we advise it to be made as follows:—

Water-colour fixative	20 gr.
Dammarine resin	3 „
Oxide of zinc	3 „

The whole well mixed together and applied with a knife.

If it be desired to apply this sizing with a brush, it may be liquefied with water-colour fixative dissolving liquid.

Either water-colour or oil painting may be done over this sizing.

MASTIC FOR FILLING UP.

Take powdered colour, according to the tone desired for the mastic, and mix it with dammarine resin, equally pulverised in the following proportions :

For almost all tones, two grammes of colour and one of resin. For vermillion three grammes of colour and one of resin. For cobalt a little more resin is required. For lakes, there should be one-half more of resin than for the other colours, but they should not be used in filling up mastics for which opaque and adhesive colours are greatly preferable.

The colour being mixed with its proportion of resin, the whole should be ground with water-colour fixative to a liquid paste, and some minutes should elapse before using it, to let it thicken to the consistency of mastic. Paste of different colours may be prepared before being wanted, and kept in bottles.

Should they dry through being badly corked, they can easily be moistened with the water-colour fixative dissolving liquid.

An equally good mastic can also be made with caseine paste and powdered colours. For this purpose the paste should be prepared a little thicker than for sizings, or more patience will be required until it thickens by evaporation. Over this paste mastic retouching or painting varnish should always be applied before painting.

MANNER OF RENDERING PAPER TRANSPARENT.

If in want of tracing paper, it can easily be prepared, by applying a good layer of essential oil of petroleum to any kind of white paper, and when that oil shall have thoroughly penetrated through the paper, wipe off any excess, from both sides, with a clean rag.

Ink and pencil take very well on paper thus rendered transparent. The transparency lasts from ten to twelve hours according to the temperature, and the petroleum is completely evaporated at the end of two days.

This method is very useful in certain cases, as it saves the trouble of tracing and retracing several times. For instance, if you wish to make a pen-and-ink drawing of a water colour or other picture with the ordinary tracing paper, you have first to trace, then take off the tracing on the white paper, and finally outline with ink: whereas by preparing with petroleum the paper itself on which you are going to draw, you may directly at one tracing make the first outline with the pen. Next day your paper is no longer transparent, and you may continue as if the paper had never had any petroleum.

PAPER FOR TAKING TRACINGS FROM OIL PAINTINGS.

To take a tracing from an oil painting, instead of using paper rubbed with black lead or red chalk, or white lead or lamp black, the tracings on which have the disadvantage of disappearing as the painting proceeds, and sometimes of soiling the tones, it is preferable to prepare a tracing paper of the shade desired by rubbing oil colour mixed with siccativ on an ordinary piece of tracing paper. In order that very little colour may remain, any excess should be well wiped off with a rag pad.

The layer of colour being very thin and very siccativ, this kind of paper is only serviceable for a few hours.

Its use has great advantages: the tracings obtained from it when dry look as if painted with a very fine paint brush; they do not run when painted with new colour—they may even be done over with semi-liquids or glazings; and they bring no foreign body into the painting. For designs on stuffs, tapestries or other ornaments which have to be traced on backgrounds, and which require going over, this kind of tracing is very convenient, because by doing it with

the exact tone, there is no need to repaint the tracing. No others should be used for tracings of perspective or architecture often done in ink, seeing that the ink does not adhere well on the painting; and if it happen to come off, it brings off the top paint, and the tracings reappear, the tones of the under part being thus laid bare.

COMMERCIAL GUARANTEE.

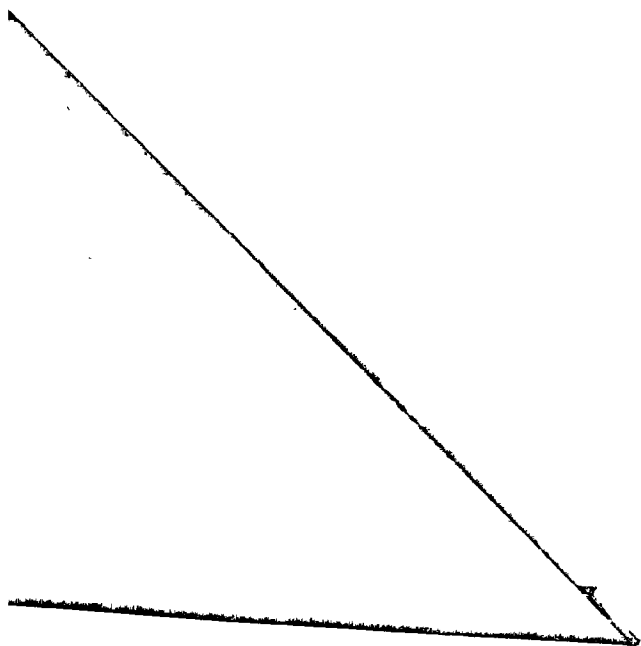
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